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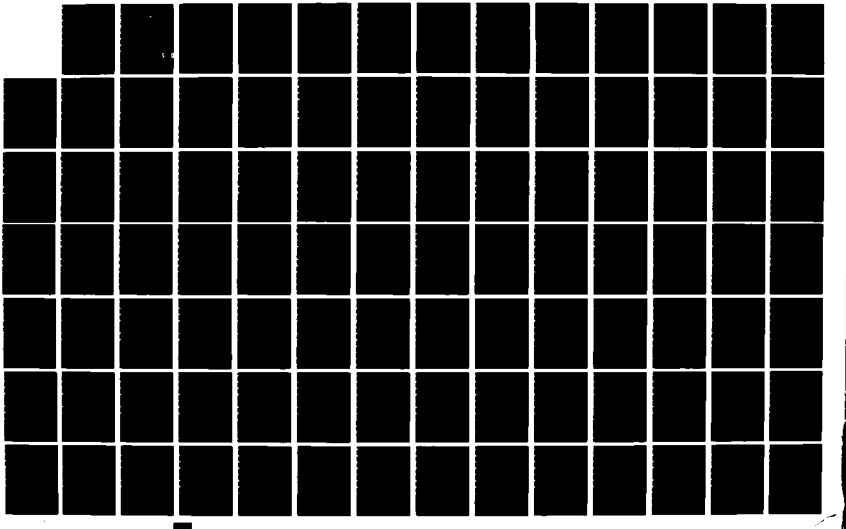

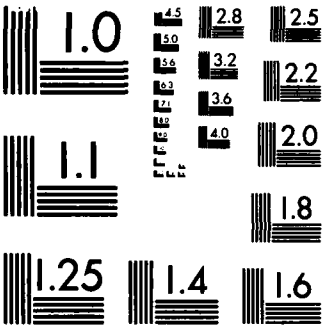

DEVELOPING SOURCE SELECTION EVALUATION CRITERIA AND STANDARDS FOR RELIABILITY AND MAINTAINABILITY

THESIS

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THESIS

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of the Air Force Institute of Technology
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Abstract

This research studied the development of source selection evaluation criteria and standards for reliability and maintainability. The data base consisted of information obtained during personal interviews with personnel from Air Force Systems Command, Aeronautical Systems Division and the Air Force Acquisition Logistics Center. Those interviewed were experienced in the development of source selection criteria and standards for reliability and maintainability.

The research culminated in the establishment of a guide for the development of source selection evaluation criteria and standards for reliability and maintainability. The guide is not specific to a particular type of system or phase in the acquisition process. The guide provides general procedures and areas of consideration for development of criteria and standards which may be applied to various acquisitions.

DEVELOPING SOURCE SELECTION EVALUATION CRITERIA AND STANDARDS FOR RELIABILITY AND MAINTAINABILITY

I. Research Proposal

Introduction

Reliability and Maintainability (R&M) issues have become the prime focus of attention within the Air Force in the development and acquisition of major weapon systems. R&M considerations must be continuously addressed to insure readiness of our Air Force. A weapon system must be able to perform with consistent reliability and be designed for efficient and effective maintainability.

The primary document initiating the focus on R&M is an action memorandum signed on 17 September 1984 by Chief of Staff Gen Charles A Gabriel and Secretary of the Air Force Verne Orr. The memorandum stresses the importance of considering R&M in the acquisition process. As stated in the memorandum,

> For too long, the reliability and maintainability of our weapon systems have been secondary considerations in the acquisition process. It is time to change this practice and make reliability and maintainability primary considerations [21:1].

The memorandum emphasizes considering R&M throughout the acquisition process. As stated in the memorandum,

> We must emphasize reliability and maintainability throughout the acquisition process -- from requirement definition, through concept development, design, production, and acceptance. Everyone must insure reliability and maintainability requirements are met through every step of the process. Reliability and maintainability must be coequal with cost, schedule, and performance as we bring a system into the Air Force inventory [21:1].

The source selection process is the avenue through which major weapon systems are brought into the Air Force inventory. The major criteria used in the source selection process have historically been cost, schedule, and performance. As quoted above, R&M must be coequal with these criteria.

Problem Statement

Proper evaluation of R&M in the source selection process is imperative to insure the most reliable and maintainable weapon systems are acquired, however, guidance is dispersed as to methods of properly establishing R&M source selection criteria and standards.

McLennan in his study of source selection evaluation criteria stated that, "A complicating factor . . . (in selecting the most appropriate criteria) . . . is that the personnel employed on source selections often have little previous source selection experience and may be approaching a difficult task with but a vague sense of direction" (6:4). With the advent of R&M 2000 and the new emphasis of

R&M as coequal with cost, schedule, and performance in source selection, the complications stated by McLennan become greater.

A study of current guidance for establishing and applying R&M source selection evaluation criteria and standards is needed to provide personnel with direction as to effective evaluation of R&M in source selection.

Background

Increased emphasis within the U.S. Air Force on the issue of reliability and maintainability considerations has directly impacted the major weapon system acquisition process. Excerpts previously stated from the 17 September 1984 action memorandum confirm this emphasis. Also stated in the memorandum is the development of an Air Force wide action plan on R&M:

> To institutionalize the Air Force commitment, Lt Gen Bob Russ and Lt Gen Marquez are forming a group of logisticians, operators, and acquisition specialists to develop an Air Force-wide action plan with specific recommendations and suspenses. This will be reported to us in early December [21:1].

On 1 February 1985, the Reliability and Maintainability Action Plan R&M 2000 was approved (20). The plan contains a multitude of actions to be accomplished to insure R&M issues are considered throughout the Air Force.

The action plan serves as further justification for the importance of this thesis in providing guidance on the effective use of R&M evaluation criteria and standards. The plan states, "The action plan is aimed at ensuring R&M is considered across all of our weapon systems and treated equally with cost, schedule, and performance" (20:i).

One of the six key management objectives in the action plan is to, "Establish industry commitment to R&M to ensure contractors have the motivation and capability to support Air Force R&M requirements" (20:i). This objective can be obtained only through proper identification of R&M requirements. These requirements are communicated in the form of R&M evaluation criteria which are contained in the Request for Proposal (RFP).

To ensure R&M is properly addressed in weapon system acquisitions, the action plan calls for the following:

> Review selected weapon systems decision documentation including the statement of need, program management directive, decision coordinating paper, request for proposal, source selection plan, acquisition plan, and R&M plan on weapon system programs to ensure R&M is adequately addressed and to assess their impact on operational support [20:7].

A further action which directly relates to this thesis is as follows:

> Publish guidebooks for implementing successful R&M programs on new and fielded systems to provide a source of R&M information for program

managers, system program managers, engineers, and other R&M functional personnel [20:9].

Adding further impetus to the importance of proper R&M Evaluation criteria and standards, the action plan states the following:

> Contractors design, develop, and manufacture weapon systems in response to the requirements and priorities expressed in requests for proposals and contracts. The specification, statement of work, and proposal evaluation factors are clear expressions of the level of the Air Force commitment and priority for R&M. Accelerated improvements in R&M can only be attained if these documents clearly communicate and reinforce the R&M commitment [20:11].

As a final action relating to this thesis, R&M 2000 requires the following:

> Increase consideration of R&M in all weapon system source selections and include R&M expertise in source selection organizations to ensure the Air Force commitment to R&M is reflected in contract awards [20:11].

General Skantze, Commander, Air Force Systems Command, in a letter dated 21 December 1984, established command-wide policy emphasizing reliability, maintainability, and producibility in the design process. General Skantze stated that, "The operational utility of our systems is fundamentally rooted in how well we have integrated reliability, maintainability, and producibility in the design process" (11:1). To implement this focus in

the acquisition process, General Skantze stated that, ". . . we are changing the source selection process criteria to add that emphasis and incentivize the contractor to focus his talents on this goal" (11:1). Specific implementation of policy in the source selection process is as follows:

> We will emphasize reliability, maintainability, and producibility in the source selection process to a higher degree than ever before. As part of the source selection process, you will single out reliability, maintainability, and producibility of the design as specific evaluation criteria items. Traditionally, we have operational suitability as the most important area, but without a corresponding ranking of these critical design parameters as specific items within that area [11:1].

General Skantze emphasizes that in a source selection for a new design, design for reliability, maintainability, and producibility are to be ranked as the first items in the highest ranked area (11:1). Offerors are also to be instructed to demonstrate thoroughly and precisely in their proposals how reliability, maintainability, and producibility are weighed in the design of their systems (11:1).

The most recent research at hand dealing with source selection criteria is an Air Force Institute of Technology thesis completed in September 1984 entitled, The Feasibility of a Decision Support System for the Determination of Source Selection Evaluation Criteria (6). Although the thesis does not specifically address R&M

criteria in source selection, the scope of the thesis is aimed at improving the source selection process through meaningful source selection evaluation criteria. Portions of the thesis research are applicable to the issue of R&M criteria. As stated in the thesis by McLennan,

> Inappropriately selected criteria renders the evaluation procedure invalid before it even starts, and an invalid source selection is not only very costly and time-wasting, but may be catastrophic for the entire project. Thus the selection of the most suitable criteria for a given acquisition is a vital element of the source selection process [6:4].

Reliability and maintainability are critical factors to be considered in major weapon system acquisitions and more specifically, as source selection evaluation criteria. The need exists for identification of critical requirements within R&M that must be addressed as source selection criteria and used to establish source selection standards. Assimilating the R&M factors into a readily available document will serve to make the source selection process more efficient as personnel will have a useful guide to aid in establishing evaluation criteria and standards. McLennan emphasizes the difficulty in establishing criteria as he states, "The selection of evaluation criteria is a particularly difficult job for the inexperienced and a potential source of future problems for the source selection process and the program" (6:5).

Scope of the Research

Through analysis of current guidance and interviews with personnel involved in R&M within Aeronautical Systems Division (ASD) and the Air Force Acquisition Logistics Center (AFALC), this thesis will provide insight into effective means of establishing R&M source selection evaluation criteria and standards.

R&M evaluation criteria and standards must be tailored to each acquisition situation based on the complexity of the weapon system being acquired and the acquisition process phase. The four basic phases of the acquisition process are: (1) concept exploration, (2) demonstration/validation, (3) full scale development, and (4) production.

R&M requirements versus acquisition process phases were discussed during a personal interview with Mr. Clay Nieman, R&M Engineer, Inertial Navigation Unit Program office (7). Mr. Nieman provided a general relationship between R&M requirements and the particular phase in the acquisition process. R&M requirements are minimal in the conceptual phase as the system design is in preliminary stages. Requirements increase during the demonstration/ validation phase and peak at full scale development as the system design is completed. R&M requirements tend to slightly decrease during the production phase.

Tables I and II, Application Matrix for Reliability and Application Matrix for Maintainability, provide personnel involved in RFP preparation with guidance as to reliability and maintainability tasks which should be included during various stages of acquisition. The particular tasks selected will depend on the system being acquired and phase of acquisition. The tables serve to illustrate the varying degree of reliability and maintainability requirements during different stages of acquisition. As can be seen, few requirements are applicable during concept exploration while at full scale development, generally all tasks are applicable. R&M tasking decreases during production.

Although R&M requirements vary for different types of systems and during various stages of acquisition, this thesis will provide general guidance which may be applied to various acquisition situations.

R&M requirements have been in existence in one form or another since the development of the first weapon system. Today, explicit guidance exists which specifies various R&M parameters and government specifications which must be built into each weapon system. For the first time, however, R&M is being stressed as the number one consideration within the technical area in source selections. In recognition of the difficulty in implementing such a

TABLE I

Reliability Application Matrix (16:A-1)

TASK	TITLE	TASK TYPE	PROGRAM PHASE			
			CONCEPT	VALID	FSED	PROD
101	RELIABILITY PROGRAM PLAN	MGT	S	S	G	G
102	MONITOR/CONTROL OF SUBCONTRACTORS AND SUPPLIERS	MGT	S	S	G	G
103	PROGRAM REVIEWS	MGT	S	S(2)	G(2)	G(2)
104	FAILURE REPORTING, ANALYSIS, AND CORRECTIVE ACTION SYSTEM (FRACAS)	ENG	NA	S	G	G
105	FAILURE REVIEW BOARD (FRB)	MGT	NA	S(2)	G	G
201	RELIABILITY MODELING	ENG	S	S(2)	G(2)	GC(2)
202	RELIABILITY ALLOCATIONS	ACC	S	G	G	GC
203	RELIABILITY PREDICTIONS	ACC	S	S(2)	G(2)	GC(2)
204	FAILURE MODES, EFFECTS, AND CRITICALITY ANALYSIS (FMECA)	ENG	S	S (1)(2)	G (1)(2)	GC (1)(2)
205	SNEAK CIRCUIT ANALYSIS (SCA)	ENG	NA	NA	G(1)	GC(1)
206	ELECTRONIC PARTS/CIRCUITS TOLERANCE ANALYSIS	ENG	NA	NA	G	GC
207	PARTS PROGRAM	ENG	S	S(2)(3)	G(2)	G(2)
208	RELIABILITY CRITICAL ITEMS	MGT	S(1)	S(1)	G	G
209	EFFECTS OF FUNCTIONAL TESTING, STORAGE, HANDLING, PACKAGING, TRANSPORTATION, AND MAINTENANCE	ENG	NA	S(1)	G	GC
301	ENVIRONMENTAL STRESS SCREENING (ESS)	ENG	NA	S	G	G
302	RELIABILITY DEVELOPMENT/GROWTH TESTING	ENG	NA	S(2)	G(2)	NA
303	RELIABILITY QUALIFICATION TEST (RQT) PROGRAM	ACC	NA	S(2)	G(2)	G(2)
304	PRODUCTION RELIABILITY ACCEPTANCE ACCEPTANCE TEST (PRAT) PROGRAM	ACC	NA	NA	S	G(2)(3)

CODE DEFINITIONS

TASK TYPE:

ACC - RELIABILITY ACCOUNTING

ENG - RELIABILITY ENGINEERING

MGT - MANAGEMENT

PROGRAM PHASE

S - SELECTIVELY APPLICABLE

G - GENERALLY APPLICABLE

GC - GENERALLY APPLICABLE TO DESIGN CHANGES ONLY

NA - NOT APPLICABLE

(1) - REQUIRES CONSIDERABLE INTERPRETATION OF INTENT TO BE COST EFFECTIVE

(2) - MIL-STD-785 IS NOT THE PRIMARY IMPLEMENTATION REQUIREMENT. OTHER MIL-STDS OR STATEMENT OF WORK REQUIREMENTS MUST BE INCLUDED TO DEFINE THE REQUIREMENTS.

TABLE II

Maintainability Application Matrix (12:A-1)

	TASK TITLE	TASK TYPE	PROGRAM PHASE				
			CON-CEPT	VALID	FSD	PROD	OPERAT SYSTEM DEV (MODS)
101	Maintainability Program Plan	MGT	N/A	G(3)	G	G(3)(1)	G(1)
102	Monitor/Control of Sub-contractors and Vendors	MGT	N/A	S	G	G	S
103	Program Reviews	MGT	S	G(3)	G	G	S
104	Data Collection, Analysis and Corrective Action System	ENG	N/A	S	G	G	S
201	Maintainability Modeling	ENG	S	S(4)	G	C	N/A
202	Maintainability Allocations	ACC	S	S(4)	G	C	S(4)
203	Maintainability Predictions	ACC	N/A	S(2)	G(2)	C	S(2)
204	Failure Modes and Effects Analysis (FMEA) Maintainability Information	ENG	N/A	S(2) (3)(4)	G(1) (2)	C(1) (2)	S(2)
205	Maintainability Analysis	ENG	S(3)	G(3)	G(1)	C(1)	S
206	Maintainability Design Criteria	ENG	N/A	S(3)	G	C	S
207	Preparation of Inputs to Detailed Maintenance Plan and Logistics Support Analysis (LSA)	ACC	N/A	S(2) (3)	G(2)	C(2)	S
301	Maintainability Demonstration (MD)	ACC	N/A	S(2)	G(2)	C(2)	S(2)

CODE DEFINITIONS

S - Selectively applicable

G - Generally Applicable

C - Generally Applicable to design changes only

N/A - Not applicable

ACC - Maintainability Accounting

ENG - Maintainability Engineering

MGT - Management

(1) Requires considerable interpretation of intent to be cost effective.

(2) MIL-STD-470 is not the primary implementation document. Other MIL-STDS or Statement of Work requirements must be included to define or rescind the requirements. For example MIL-STD-471 must be imposed to describe maintainability demonstration details and methods.

(3) Appropriate for those task elements suitable to definition during phase.

(4) Depends on physical complexity of the system unit being procured, its packaging and its overall maintenance policy.

requirement, this thesis will help insure that proper evaluation criteria and standards are established so that the most reliable and maintainable systems are acquired.

Summary and Preview

This chapter has provided the justification for the research effort to include an introduction to the subject, problem statement, background of the problem, and finally, the scope of the research.

Chapter II will provide a literature review of the source selection process to include applicable regulations, source selection objectives, source selection organization, the source selection plan, evaluation criteria, and evaluation standards. Also included in the literature review is an overview of reliability and maintainability as it applies in source selection.

Chapter III will be the methodology used in the research. The chapter will include the research population, data base, limitations to the data base, the research instrument, and data analysis. Chapter IV provides the findings obtained based on examination of data. Chapter V provides conclusions and recommendations for further research.

II. Literature Review

Introduction

This chapter will provide an overview of the source selection process through a review of appropriate Department of Defense and United States Air Force publications. This chapter will also include an overview of R&M with emphasis on the application of R&M in source selection.

Applicable Regulations

Department of Defense Directive (DODD) 5000.1, Major Systems Acquisition Procedures (14) and Department of Defense Instruction 5000.2, Major Systems Acquisition Procedures (13) provide mandatory policy in regards to contracting for major weapon systems. Source selection policy is guided by DODD 4105.62, Selection of Contractual Sources for Major Defense Systems (17). These documents discuss the acquisition process and source selection process at a general level. Guidance at a more operational level is contained in Air Force Regulation (AFR) 70-15, Source Selection Policy and Procedures (23). AFR 70-15 will be the main source of reference for the literature review on source selection. Applicable Air Force Systems Command (AFSC) and Aeronautical Systems Division (ASD) supplements to AFR 70-15 along with ASD guides to source

selection will also be utilized due to current guidance being issued emphasizing the application of R&M in source selection.

A multitude of regulations exist detailing R&M policies, guidelines, and procedures. In order to provide a broad overview of R&M and how it applies in source selection, DODD 5000.40, Reliability and Maintainability (15), and AFR 800-18, Air Force Reliability and Maintainability (18) will be the main sources of reference for the literature review of R&M.

Source Selection Objectives

DODD 4105.62 states the three primary objectives of the formal source selection process as follows (17:2):

> (a) select the source whose proposal has the highest degree of realism and credibility and whose performance is expected to best meet Government objectives at an affordable cost;
>
> (b) assure impartial, equitable, and comprehensive evaluation of competitors' proposals and related capabilities; and
>
> (c) maximize efficiency and minimize complexity of solicitation, evaluation and the selection decision.

The principal objective of the source selection process as stated in AFR 70-15 is,

> . . . to select the source whose proposal has the highest degree of credibility and whose performance can be expected to best meet the government's requirements at an affordable cost.

> The process must provide an impartial, equitable, and comprehensive evaluation of competitor's proposals and related capabilities [23:3].

Source Selection Organization

Figure 1 provides the overall source selection organization. The official designated to direct the source selection process and make the source selection decision is the Source Selection Authority (SSA). The SSA is responsible for proper and efficient conduct of the process to include proposal solicitation, evaluation, selection, and contract award (23:5).

The SSA is advised by the Source Selection Advisory Council (SSAC). The SSAC provides the SSA with a comparative analysis of evaluation results of the Source Selection Evaluation Board (SSEB) (23:5). The SSAC receives and approves evaluation standards developed by the Program Office and determines if it is desirable to weight evaluation criteria (23:5).

The SSEB is a group of government personnel representing various functional and technical areas relevant to the acquisition (23:5). The SSEB evaluates proposals and reports to the SSAC. Evaluation of proposals is accomplished through an in-depth review and evaluation of each proposal against solicitation requirements, approved evaluation criteria, and the standards (23:5).

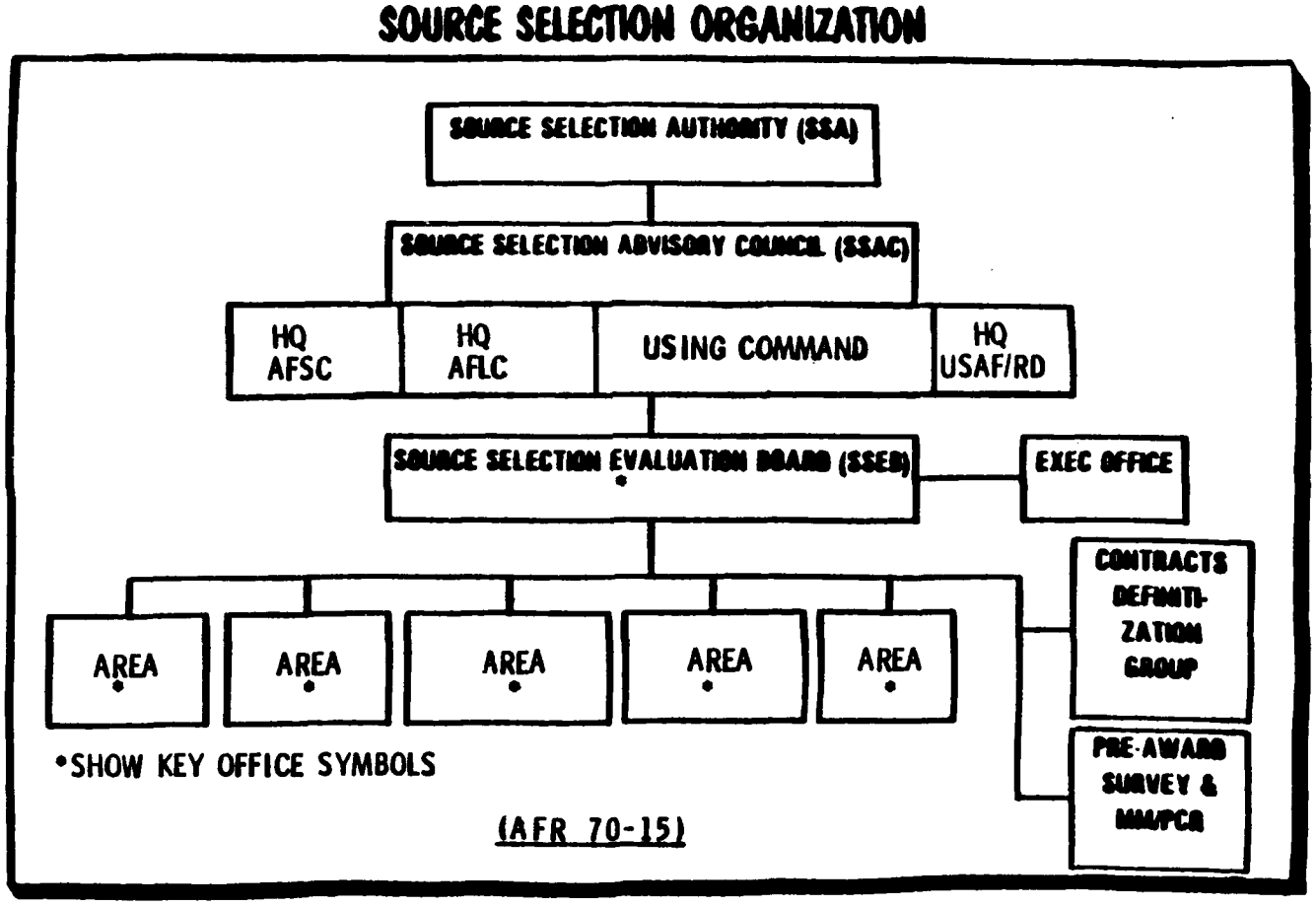

Fig. 1. Source Selection Organization [19]

The Source Selection Plan

The Source Selection Plan (SSP) is the key document initiating a source selection. The SSP contains procedures used to evaluate proposals for contract award. According to AFR 70-15, the following is to be contained in the SSP:

> Describe the specific evaluation criteria including, areas, items, and where appropriate, factors and subfactors. Describe the assessment criteria and how they apply to the evaluation. The relative importance of all evaluation criteria will be stated . . . [23:8]

The Program Office is responsible, among other things, for establishing evaluation criteria for SSA approval as part of the SSP (23:6). The Program Office establishes the relative importance of the evaluation criteria in the SSP in a form for use in the solicitation and develops evaluation standards for SSAC approval (23:6).

The Source Selection Plan Preparation Guide, AFR 70-15/ASD Pamphlet 800-7 dated June 1985 emphasizes the importance of including R&M in the SSP. The guide states, "A topic that must be thoroughly assessed during development of the SSP is Product Assurance" (22:1). As R&M falls within the area of Product Assurance, the guide goes on to state, "This consideration must include reliability, maintainability, and producibility and any other considerations needed to assure product excellence" (22:1).

Evaluation Criteria

AFR 70-15 defines evaluation criteria as, "The basis for measuring each offeror's ability as expressed in its proposal, to meet the government's needs as stated in the solicitation" (23:3). Evaluation criteria are defined at the time the SSP is prepared and become a part of the SSP and must be included in the solicitation (23:8). Evaluation criteria must be tailored to each program. Specific criteria should be related to characteristics important to program success such as maintainability, producibility, supportability, and system effectiveness (23:9).

Evaluation criteria consist of specific and assessment criteria that provide a matrix which identifies and interrelates what is to be evaluated (23:8). Figure 2 provides an example of a general format for matrix of evaluation criteria.

Specific criteria relate to program characteristics and include areas of evaluation. Areas of evaluation are subdivided into items, factors, and at times, subfactors. The level of subdivision depends on the complexity of the area being evaluated (23:9). Typical areas include; technical, logistics, manufacturing, operational utility, test, and management (23:9). Assessment criteria relate to the offeror's proposal and abilities and may be ranked in

order of relative importance (23:9). Assessment criteria normally include the following (23:9):

a. Soundness of technical approach

b. Understanding of the requirement

c. Compliance with the requirement

d. Past performance

e. Impact on the schedule

GENERAL FORMAT FOR MATRIX OF EVALUATION CRITERIA
AREA
(Technical, Logistics, Test, Management, etc.)

Specific Criteria / Assessment Criteria	Item 1 Description		Item 2 Description		Item 3 Description	Item 4 Description
	Factor 1	Factor 2	Factor 1	Factor 2		
Soundness of Approach	COLOR	COLOR	COLOR	COLOR		
Understanding of Requirement						
Past Performance						
Compliance with Requirement						
Other Assessment Criteria						

NOTES:
1. If a factor is displayed graphically it must be color coded.
2. If one factor for an item is displayed, all factors for all items within the area must be displayed.

Fig. 2. Matrix of Evaluation Criteria [23:9]

Figure 3 provides a visual representation of the relationship between areas, items, and factors. The figure also portrays the increased emphasis being placed on reliability, maintainability, and producibility by moving these considerations from factors to an item. As stated in current guidance contained in Interim ASD Supplement 1 (Revision 1) to AFR 70-15 dated 21 March 1985,

> Coequal with technical performance as number one ranking in the technical area will be reliability and maintainability; producibility and quality engineering will also rank close to the top of the technical area. In addition, the applicable instructions to offerors must instruct offerors to demonstrate thoroughly and precisely in their proposals how reliability, maintainability, and producibility are weighed in the design of the system [24:3].

The above guidance is also contained in the ASD Source Selection Plan Preparation Guide dated 17 June 1985 (22:1).

Evaluation Standards

According to AFR 70-15, evaluation standards establish the minimum acceptable level of compliance with a requirement that must be offered for a proposal to be considered acceptable (23:9). Standards may be either quantitative or qualitative depending on the factor or subfactor they address (23:9). Standards are also used for measuring how well each offeror's approach meets the

SOURCE SELECTION EVALUATIONS

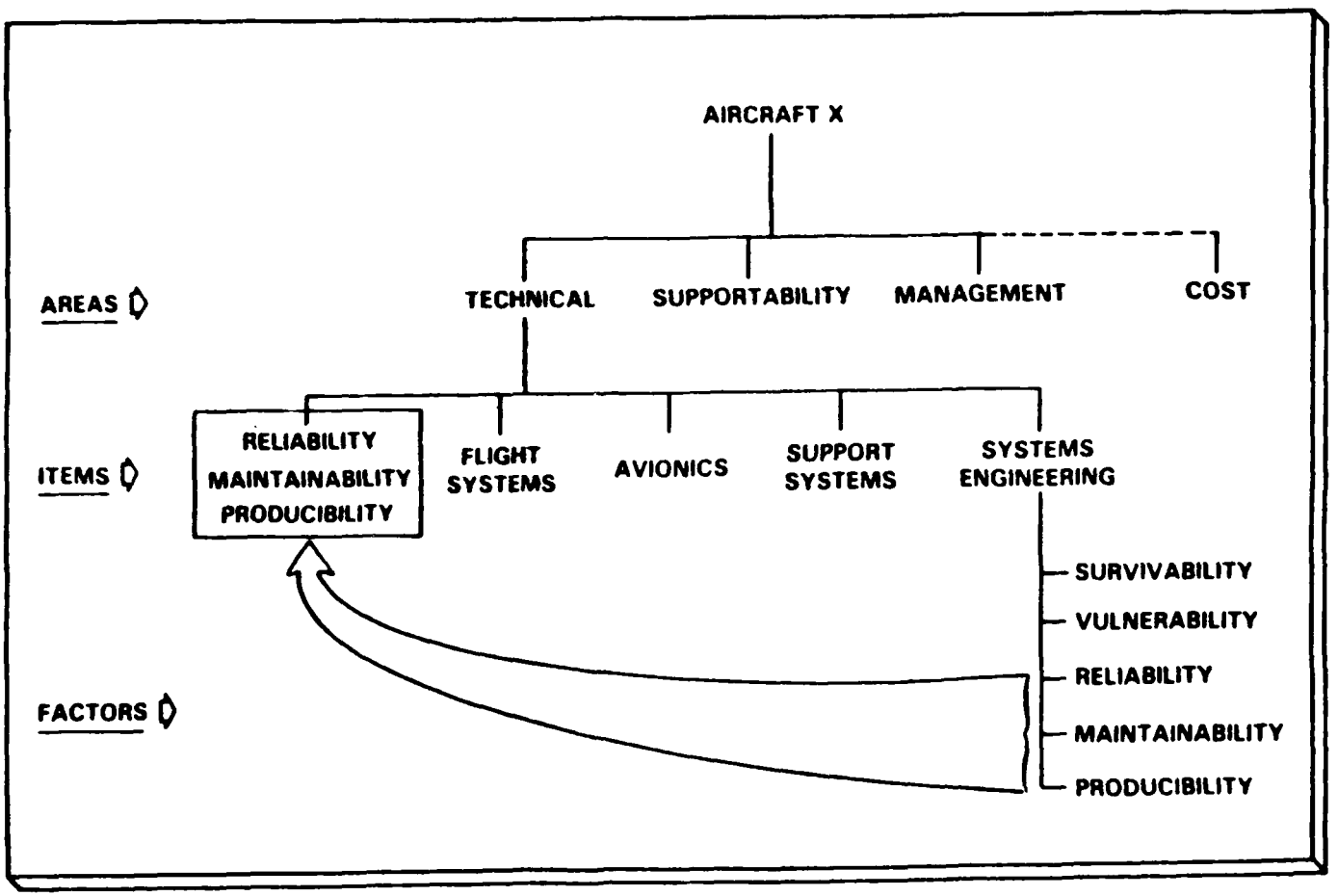

Fig. 3. Source Selection Evaluations

requirements and to determine when an offeror fails to meet requirements, or exceeds requirements (23:9).

Standards are not included in the SSP or the solicitation and are not to be released to any potential offeror or personnel not directly involved in the source selection (23:9). Safeguarding of standards is required to prevent offerors from obtaining an unfair advantage through receiving standards prior to submission of proposals. After contract award, standards relating to a specific contract are safeguarded to help prevent disputes arising from offerors who did not receive the contract and who may seek to refute specific standards.

Evaluation of proposals by the SSEB is conducted by measuring each proposal against objective standards established at the lowest level of subdivision (23:9). Proposals are not compared against each other (23:9).

Reliability and Maintainability Literature Review

DODD 5000.40 defines reliability and maintainability as follows:

> Reliability - The duration or probability of failure-free performance under stated conditions.
>
> Maintainability - The ability of an item to be retained in or restored to specified conditions when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair [15:10].

The general policy concerning R&M as stated in DODD 5000.40 is as follows:

> Reliability engineering shall focus on the prevention, detection and correction of design deficiencies, weak parts, and workmanship defects. Maintainability engineering shall reduce maintenance and repair time, number of tasks required for each preventative and corrective maintenance action, and the need for special tools and test equipment. Program plans shall stress early investment in R&M engineering in order to avoid subsequent costs and schedule delays [15:2].

This philosophy of early investment in R&M engineering must be carried into the source selection process. The R&M engineering policy states that, "The DOD components shall define fundamentals of design, manufacture, and management which will result in delivery of reliable and maintainable items to the operational forces" (15:2). DODD 5000.40 identifies fundamentals in design, manufacturing, and engineering tasks and tests (15:2). The level of R&M built into a system is to a great extent dependent upon the intended use of the system and required level of efficiency. As stated in DODD 5000.40,

> Tradeoffs between performance and reliability, and among required values for system R&M parameters, shall balance the design effort devoted to operational effectiveness with that devoted to ownership cost reduction [15:4].

As further evidence of the need to insure R&M is effectively considered as criteria and standards in source selection, DODD 5000.40 states that,

> R&M growth is required during full scale development, concurrent development and production (where concurrency is approved), and during initial deployment. Predicted R&M growth shall be stated as a series of intermediate milestones, with associated goals and thresholds for each of these phases [15:4].

Throughout the major weapon system acquisition process, source selections are made. R&M must be stressed during each phase and within each source selection. This is supported in DODD 5000.40 as follows:

> Program review and decision authorities shall address R&M achievements of the preceding phase, and preparations for the following phase, at each major milestone decision or equivalent point in the acquisition process [15:5].

DODD 5000.40 identifies key areas of R&M within each phase of the major weapon system acquisition process (15:5). The phases include mission analysis, conceptual, demonstration and validation, full scale development, and production and deployment.

AFR 800-18 stresses the importance of considering R&M throughout the acquisition process as follows:

> Each acquisition and system manager will assign an R&M focal point and implement an R&M program. The program will support cost, schedule, performance and supportability considerations of the acquisition and operational phases of a system.

> The definition, development, production, and operation of a system will be guided by realistic R&M requirements developed during the conceptual and validation phases. R&M qualitative, quantitative, and program requirements will be imposed and enforced in acquisition contracts [18:2].

AFR 800-18 addresses the use of R&M in the source selection process:

> The R&M programs proposed by contractors are key factors to be considered during source selection. They are evaluated for their impact on system design, system effectiveness, and life cycle costs [18:3].

As in DODD 5000.40, AFR 800-18 addresses R&M considerations within each phase of the major weapon system acquisition process. AFR 800-18 goes into much greater detail on these considerations than does DODD 5000.40. R&M must be considered during each phase of the weapon system acquisition process and, concurrently, within each source selection.

III. Methodology

Introduction

This chapter will discuss the approach used to study current procedures used in the selection of appropriate evaluation criteria and standards for R&M in source selection.

The determination of appropriate criteria and standards for R&M is a complex process. In order to effectively study the process, experienced personnel involved in the establishment of source selection criteria and standards for R&M were interviewed.

Population

In order to obtain a broad perspective on the application of R&M in Air Force Source Selections, personnel from Air Force Systems Command (AFSC), Aeronautical Systems Division (ASD) System Program Offices (SPOs) and the Air Force Acquisition Logistics Center (AFALC) were interviewed. SPOs at ASD are involved in a multitude of programs ranging from major weapon systems to subsystems. Personnel involved in development of R&M criteria and standards at the major weapon system and subsystem level comprise the research population.

Data Base

Personnel interviewed within ASD SPOs and AFALC were R&M Engineers experienced in the development of R&M criteria and standards. These individuals are also involved in implementing R&M in the source selection process.

Research Instrument

A questionnaire was developed which served as the basis for questions asked during interviews. The nature of the research necessitated development of open-ended questions. Validation of the questionnaire took place through completion of the first two interviews. As a result of these interviews, the questionnaire was reduced to 11 questions from an original 14 questions. The first two interviews reflect the revised 11 questions as do subsequent interviews. Insight into the establishment of R&M criteria and standards was gained through the personal experiences of those interviewed. The following questions were administered during the personal interviews:

1. What sources of reference are used for developing R&M criteria and standards? If previous contracts are used, what should have or could have been used?

2. Is there a list of criteria and standards (boiler plate) from which to choose appropriate criteria to

tailor to each system? What are key areas that make one system unique from another?

3. What is done to insure that requirements in the Statement of Work (SOW) are stated in such a way as to allow for the development of evaluation criteria? Are R&M personnel involved in RFP preparation/review to help insure proper statement of requirements?

4. What can be done to improve stated requirements to insure that evaluation standards can be developed?

5. Are standards ranked in such a way as to give proper weight to more critical R&M requirements in the RFP?

6. At what level is R&M currently applied in source selection (item, factor, subfactor)? How was R&M applied prior to R&M 2000?

7. What have you found to be the easiest and most difficult R&M areas to evaluate? Why?

8. Are there any recurring problems in evaluating R&M? Were contractors non-responsive to any of the R&M requirements?

9. How difficult has it been to involve other personnel from various functional areas in R&M evaluation?

10. Do you believe R&M was properly addressed in source selection prior to R&M 2000? Do you believe R&M 2000 will be effective in emphasizing R&M in source selection?

11. What recommendations do you have for improving development of criteria and standards for R&M?

The basis for establishing each of the above listed questions was as follows:

Question 1 was developed to obtain a list of references for individuals involved in development of criteria and standards. The references are not meant to be all inclusive, however, are intended to provide a general list of available sources of reference.

Question 2 was developed to determine if a document was available which personnel could use as a guide when developing criteria and standards. A list of criteria and standards would provide basic guidance as to appropriate wording and areas to address. Appendix J, along with providing a basic philosophy to follow in developing criteria and standards, will also contain examples.

Question 3 addressed the important issue of ensuring that SOW requirements are stated in such a way that criteria can be developed. SOW requirements must be explicit in order to allow development of criteria that will be effective in determining the contractor's capability. It is important that R&M personnel are involved throughout the process of RFP preparation and review. This ensures that R&M requirements are properly stated and do not conflict with other requirements in the RFP.

Question 4 seeks to determine ways to improve stated requirements to allow development of standards. Standards must be able to judge particular capabilities of contractors. Standards must judge contractors equally and be developed from clearly stated requirements in the SOW.

Question 5 was developed to determine if ranking of standards takes place. Certain R&M requirements are more critical than others, therefore, a method should exist for placing greater weight on more critical requirements.

Question 6 was designed to determine the extent of implementation of current guidance which increases the priority of R&M in source selection.

Question 7 was developed to determine those areas within R&M that were easier and more difficult to evaluate. Answers to this question provide areas that need to be stressed as criteria and standards and also helps ensure personnel are prepared to evaluate the more difficult areas.

Question 8 also provides guidance as to R&M areas which may pose problems to evaluators. Evaluators must attempt to resolve and prevent recurring problems.

Question 9 evaluates the extent to which R&M personnel receive support from various functional areas. In order for R&M to be effectively implemented at the

organizational level, Command level, and Air Force level, personnel within all functional areas must be involved in emphasizing R&M throughout the acquisition process.

Question 10 was developed to determine the perspective of R&M Engineers as to the impact of R&M 2000.

Question 11 was designed to allow R&M Engineers experienced in the development of criteria and standards to provide personal recommendations and insights for improving the process of developing criteria and standards.

Data Analysis

Analysis of the interview results will not involve quantitative procedures, but rather a qualitative review and compilation of interview responses. An analysis consisting of an integration of responses to the open-ended questions allows the overall views of those interviewed to be readily available. Individual responses to the questions are contained in the appendices.

IV. Findings

Introduction

This chapter provides the findings of the research based upon responses obtained in the personal interviews. Comprehensive answers to each of the research questions are contained in the appendices. Here, the responses will be summarized and categorized according to a key word or phrase contained in each question administered during the interviews.

As expressed in the problem statement, Chapter I, guidance is dispersed as to methods of properly establishing R&M source selection criteria and standards. The personal interviews provided first hand knowledge of the process used to establish R&M criteria and standards. The findings will present concensus in certain areas as well as conflicts and criticisms in others. Overall, a comprehensive review of the process is given based on the opinions of experienced R&M Engineers from several Program Offices at ASD and within AFALC.

Appendix J utilizes the findings along with additional information received in the interviews such as checklists and examples of R&M criteria and standards to form a guide to the development of R&M criteria and standards. The guide provides broad guidance not peculiar to a

specific system or stage of the acquisition process, although at times qualifications are made to specify a particular size program or stage of acquisition.

References Used

In developing criteria and standards, the basic source of reference is the Statement of Work (SOW). The SOW establishes the requirements of the RFP. In order to evaluate contractors based on certain requirements, the requirements must be expressed in the evaluation criteria contained in Section L of the RFP, Instructions to Offeror.

Several of those interviewed indicated that previous contracts were referenced. The extent to which a previous contract can be used depends on the similarity among systems being acquired. In some instances only the format from the previous contracts was used whereas in others, only minor changes were necessary in order to use the criteria and standards. Regardless of the degree of similarity between systems, previous contract criteria and standards if used as a reference must always be tailored to the system being acquired.

Several Military Standards and Handbooks on R&M are available. The Standards and Handbooks provide detailed guidance on particular R&M tasks and requirements. The most frequently referenced document was MIL STD 785B and MIL STD 781C.

The majority of those interviewed had a vast amount of experience in the development of R&M criteria and standards. Those interviewed with less experience used the experience of others. On the surface, this may seem a subtlety, however, it is often under utilized. Given the large number of diverse programs at ASD, a wealth of knowledge exists which less experienced personnel should take advantage of when developing criteria and standards.

List of Criteria and Standards

No approved list of criteria and standards exists from which to tailor to a system. Several of those interviewed developed personal guidelines based on experience and previous contracts. One example of a boiler plate type of outline did exist for use in developing criteria and standards and is contained in the guide in Appendix J.

An area identified as making one contract unique from another was whether the system was a major system or subsystem. A major system generally requires more extensive R&M criteria and standards.

Whether a system is mainly electrical or mechanical also makes a system unique. R&M requirements must be tailored to account for this difference. For example, R&M test requirements will differ for an electrical system versus a mechanical system.

Stating Requirements for Criteria Development

R&M personnel must be involved throughout RFP preparation and review to insure R&M requirements are properly stated.

To allow for development of criteria, requirements in the SOW should be stated in general terms without detail to the extent of influencing the contractor's design. Also, the same person developing the SOW should also develop the criteria. This provides for consistency of thought and allows for development of criteria by an individual with full knowledge and background of the SOW requirements.

Requirements should be stated in commercial terms to allow contractors with less experience in government work to be able to understand the requirements. This would help in development of standards as contractors are less likely to be non-responsive to certain RFP requirements.

At times, R&M requirements are stated in both the technical and logistics areas. However, R&M should only be stated in one of the areas, preferably technical to avoid a conflicting statement of requirements.

Requirements should not influence or restrict the design process during the conceptual and demonstration/validation phases. Therefore, the particular phase in the acquisition process should also be considered when developing SOW requirements.

Stating Requirements for Standards Development

Standards are essentially used to determine whether or not the contractor has satisfied the requirements stated in the evaluation criteria in the RFP. Criteria must be stated in such a way that contractors submit justification and data to support their ability to perform the various requirements. Contractors must not simply restate the SOW. Standards are developed to judge the ability of the contractor to meet the criteria.

As with development of criteria, requirements in the SOW must not be too specific. They must be stated clearly and unambiguously. There is a fine line between too specific and too general, however, the design process must not be inhibited. The same person developing the SOW requirements and criteria should also develop the standards.

A checklist type of document would help in the development of standards. The SOW requirements could be cross-referenced with important areas to consider in the standards. Each acquisition would require tailoring, however, key areas to be considered as standards could be identified.

R&M tasks must be tailored to the specific system. At times, tasks are incorporated into the RFP and not tailored. This causes difficulty in developing standards to evaluate R&M capability for a specific system.

Ranking Standards

An official ranking of standards does not take place, however, standards are subjectively ranked. The subjective ranking depends upon the evaluator. Certain R&M requirements may be considered more important than others, therefore, the ability of the contractor to demonstrate capability in the more important areas will have a greater influence in determining compliance with the overall R&M requirement.

When R&M is considered as an item in source selection, factors and subfactors can be assigned a certain weighting. The weighting assigned, however, is subjective. A factor such as R&M predictions may receive a certain ranking. Predictions can indicate the degree to which the contractor understands R&M requirements when predictions are not in the general range of the government estimate.

Current Application of R&M in Source Selection

For the majority of those Program Offices interviewed, R&M is considered as the number one item under the technical area in source selection. Where R&M has not reached the item level, priority has increased from the subfactor to the factor level. Prior to R&M 2000, the majority of Program Offices considered R&M at the factor or subfactor level. It appears that R&M 2000 has provided the necessary impetus to allow R&M to receive the increased priority.

Difficulty in Evaluating R&M

The SOW tasks such as test plans and specifications were identified as easier R&M requirements to evaluate. Evaluation of data submitted was identified as a difficult area to evaluate. At times, contractors submit volumes of data. It is up to the evaluator to determine if the data is reasonable or makes sense.

Proposals submitted during the conceptual phase of acquisition are also difficult to evaluate as requirements are vague. There is often no past information available from which to judge the reasonableness of proposals. Future capability is difficult to evaluate. When a system will not be produced for 5-10 years, it must be determined if the contractor will have sufficient capability in the future. Many uncertainties exist in evaluating this area.

Evaluation of R&M during the full scale development and production phases of acquisition are easier. During these phases, R&M tasks and requirements are fully identified; therefore, evaluators know what contractors need to provide in proposals to adequately show R&M capability.

Contractor analysis of R&M includes identification of critical R&M items in the system. It is difficult to dispute the selection of critical items by the contractor. Also, in order to evaluate critical items, the evaluator

must be familiar with the data submitted along with procedures used to collect the data and field maintenance procedures. Contractor R&M predictions also involve an indepth evaluation and are often difficult to dispute.

Maintainability in general is difficult to evaluate as it is difficult to conceptualize maintainability on paper. It often takes hands-on experience with a system to identify maintainability problems. Evaluators must often rely only on data and designs submitted to determine the maintainability of the system.

Past performance of a contractor on R&M requirements is difficult to evaluate as information is often not available in the source selection on R&M past performance.

The evaluation of R&M budgeted growth curves is difficult. Often times, determination of start points and slopes are a matter of judgement. Data is not available to refute the contractor's submission.

Recurring Problems in Evaluating R&M

A recurring problem has been a lack of sufficient data submitted with proposals. Also, at times there is a lack of technical understanding of certain R&M requirements. This may be indicated by a contractor being non-responsive to an R&M requirement. Non-responsiveness may also indicate that R&M requirements or criteria were not clearly stated.

Analysis of data is a problem when a vast amount of data is submitted and limited time is given to determine the accuracy of the data.

Contractors have been reluctant to perform environmental stress screening at the parts level as contractors claim the screening is performed before receipt of the parts. As a result, this requirement was generally waived in the past by the government.

A negative attitude toward R&M in industry has caused problems. This may have been a reflection of government emphasis on R&M. Contractors will generally respond to those areas where emphasis is placed.

At times, source selection management may cause problems when guidance is changed as to the documentation that is required during the source selection.

Involvement of Other Personnel

It has not been difficult to involve personnel from various functional areas in the evaluation of R&M. The degree to which personnel outside the R&M function become involved is dependent on the size and complexity of the particular program.

With the current emphasis on R&M, other workload on R&M engineers has increased due in part to the number of questions raised that require elaborate replies. This

makes it more difficult to involve experienced R&M engineers in the actual source selection. Therefore, proper statement of criteria and standards is becoming increasingly important due to the lack of experienced R&M personnel in source selection.

R&M 2000 Impact

The main concensus among those interviewed was that R&M requirements for a weapon system were properly addressed in the past. However, R&M did not receive the required priority in source selection. Prior to R&M 2000, it was up to the discretion of source selection management to determine the priority of R&M. At times, this discretion was used to loosen the interpretation of R&M requirements.

There had been a grass roots push to increase the priority of R&M prior to R&M 2000. R&M 2000 provided the necessary upper level management attention and Air Force-wide attention to make R&M the prime focus of attention.

Those interviewed believe that R&M 2000 will be effective in emphasizing R&M in source selection. Upper level management, however, must continue to support and emphasize R&M.

Recommendations for Improving Development of Criteria and Standards

Several recommendations for improving development of criteria and standards for R&M were provided by those interviewed. The recommendations are listed below:

1. The ultimate R&M objectives for the program must be kept in mind. The criteria and standards serve as the means of obtaining the objectives.

2. Source selection standards should be written prior to release of the RFP. When standards are not written at the same time as the SOW and evaluation criteria, different personnel may be tasked to write the standards. This causes inconsistency of thought and also a loss of knowledge as to system peculiarities that were known by the individual who developed the SOW and criteria.

3. Personnel should not hesitate to seek the advice of an experienced R&M engineer when tasked with developing criteria and standards.

4. R&M could be more effectively evaluated if operational terms could be directly correlated with contractual terms. It is often difficult to determine if operational requirements are satisfied even when all contractual requirements have been fulfilled. In order to translate an operational requirement into contractual terms, several subsystem MTBFs and other measures must be combined.

5. Additional time should be built into acquisition milestones to allow for proper development of the RFP SOW for R&M. Proper development of criteria and standards hinges on a well written SOW.

6. R&M Engineers should ensure that Program Managers become familiar with R&M as it relates to their particular program. This will help ensure proper emphasis is placed on R&M throughout the various phases of the program.

7. Additional guidance in the form of checklists or examples would improve the development of criteria and standards. R&M Engineers should develop personal lists of standards and detailed questions for use in future programs.

8. Increase the number of R&M Engineers. Current emphasis on R&M through R&M 2000 causes increased workload on R&M Engineers in the form of additional documentation requirements, development of policy, and replies to higher level inquiries. Additional manpower is needed to handle the increased workload to allow sufficient time for development of criteria and standards.

V. Conclusions and Recommendations

Introduction

This chapter will restate the problem statement in order to determine the extent to which the identified problem was solved through this research effort. The conclusion will summarize the approach used and findings of the research which led to solution of the problem. This chapter will also provide recommendations for further research.

Problem Statement

Proper evaluation of R&M in the source selection process is imperative to insure the most reliable and maintainable weapon systems are acquired, however, guidance is dispersed as to methods of properly establishing R&M source selection evaluation criteria and standards.

A study of current guidance for applying R&M source selection evaluation criteria and standards is needed to provide personnel with direction as to effective evaluation of R&M in source selection.

Conclusions

Through personal interviews with R&M engineers experienced in the development of R&M evaluation criteria and standards, current guidance and procedures for establishing R&M criteria and standards was studied.

The interviews provided valuable personal experience and data which served as the basis for establishment of a guide for development of source selection evaluation criteria and standards for R&M. The guide is contained in Appendix J.

As identified in the problem statement, guidance is dispersed as to methods of properly establishing R&M source selection evaluation criteria and standards. Appendix J provides a concise compilation of guidance and procedures to use when developing criteria and standards for R&M. The guide provides personnel involved in the development of criteria and standards with a systematic process and important areas that must be taken into consideration to develop effective R&M criteria and standards.

With the current emphasis being placed on the importance of R&M, in particular, the increased priority of R&M in the source selection process, this thesis has provided research results that help implement the current emphasis. In order to acquire weapon systems that are more reliable and maintainable, R&M must be addressed in source selection. For R&M to be effectively addressed, evaluation criteria and standards must be properly developed. This thesis serves to ensure proper development of R&M source selection evaluation criteria and standards.

Recommendations for Further Research

This research has identified areas which should be pursued in further research efforts. The following recommendations for further research are provided:

1. Research should be conducted to determine an effective way of translating operational R&M requirements into contractual R&M requirements and vice versa. It is often difficult to determine if operational requirements are satisfied even when all contractual requirements are met. To translate an operational requirement into a contractual requirement, several contractual measures such as MTBF and MTBM must be combined to satisfy an operational situation. An effective method of translating operational requirements into contractual requirements would allow personnel to more clearly specify R&M requirements in the SOW, and as source selection criteria and standards.

2. Research should also be conducted to determine a ranking structure or weighting of R&M within source selection. With R&M elevated in source selection to the number one item under the technical area, the R&M item will have various requirements as factors and subfactors. Certain R&M requirements are more critical to the success of a system than others. More critical R&M requirements should be identified and a weighting system developed to ensure that these requirements receive greater consideration in determining the most reliable and maintainable system.

Appendix A: Personal Interview

Name: Robert Armstrong
Organization: Airlift and trainer, ASD/AFES
Duty Title: R&M Engineer
Experience: Development of R&M criteria and standards.
Advisor for the Advanced Rescue Helicopter.
Item Captain for the Next Generation Trainer.

Question 1--Previous contracts were used for reference as well as personal experience of others in development of criteria and standards. Mr. Armstrong had no prior experience in this area and found little guidance available.

Question 2--Sample formats existed which were tailored to the system. No unique areas were identified.

Question 3--Avoid ambiguous statements in the SOW. Criteria should be written when the SOW is written. R&M personnel are involved throughout RFP preparation and review.

Question 4--Requirements should be stated in such a way that contractors who do not deal with the government often can understand the requirements. For instance, for the Next Generation Trainer, Cessna Corporation had trouble with certain requirements as their business is mainly commercial rather than military.

Question 5--Subjective ranking of standards takes place. There is no official ranking. It would be hard to assign weighting to the standards.

Question 6--R&M is considered as an item under the technical area as well as an item under the logistics area. This was being done prior to R&M 2000.

Question 7--The easiest areas are the SOW tasks such as test plans and schedules. It is difficult to evaluate R&M predictions and growth curves. Contractors did not use past data to estimate the growth curves and the government had little knowledge of what the slope of the growth curves should be.

Question 8--A recurring problem is analysis of the data submitted. At times, volumes of data can be submitted with little time to evaluate.

Question 9--It has not been difficult to involve other personnel in R&M evaluation.

Question 10--R&M was not properly addressed prior to R&M 2000. There was not enough emphasis on R&M. There was little interest in the details of a good R&M program. It was addressed because it had to be. R&M 2000 will be effective if upper management continues the emphasis.

Question 11--Development of criteria and standards would improve if a checklist was available which indicated important areas to consider. Personnel should also learn what to expect from a proposal. This would help avoid asking for too little or too much information.

Appendix B: Personal Interview

Name: Wallace Detert
Organization: Tactical Systems, ASD/TAES
Duty Title: R&M Engineer
Experience: Development of R&M criteria and standards for the C-141, C-130, C-5, A-10, F-15, F-16, ATF, and a number of subsystems.

Question 1--Previous contracts for similar systems are often a source of reference. Criteria and standards must be tailored to the particular system. Various R&M handbooks are available detailing R&M specifications and tasks. MIL STD 785 and MIL STD 781 are also used as sources of reference.

Question 2--There is no list of criteria available. Key areas on a system are the fasteners. Mr. Detert has observed numerous hours being spent replacing defective fasteners.

Question 3--The SOW must be clearly delineated and succinct. Criteria should not be too detailed as to tie the contractors hands. The SOW must consider the particular phase of acquisition as the SOW requirements should not influence or restrict the design process during conceptual and demonstration/validation phases. R&M personnel are involved with RFP preparation and review.

Question 4--Experienced personnel must be involved in the development of the SOW. A checklist approach should not be used as each acquisition is unique. The person

developing the SOW should also develop the standards. Standards must not be too detailed as to inhibit evaluations. Contractors must be free to submit innovative approaches to satisfy government requirements. Standards must be developed in such a way that innovative approaches can be evaluated.

Question 5--Generally weighting of standards is not accomplished. Certain areas of R&M receive subjective ranking which impact on the overall evaluation of R&M.

Question 6--R&M is currently the number one item under the technical area. R&M was previously considered as a factor.

Question 7--Evaluating the contractor's analysis of R&M is the most difficult. Analysis deals with the identification by the contractor of critical R&M items within a system. Analysis must be done correctly to insure proper design of a system. In order to evaluate the contractor's analysis, one must be familiar with data collected as well as procedures used to collect data. Field maintenance procedures must also be known.

Question 8--A recurring problem has been a negative attitude toward R&M in industry.

Question 9--It has not been difficult to involve other personnel in R&M evaluation. Recently, personnel have become too involved in the sense that personnel who are not well versed in R&M are asking questions due to the

emphasis of R&M 2000. Questions from upper levels necessitate elaborate replies which have tended to increase the workload among an undermanned R&M Engineering force.

Question 10--R&M was properly addressed prior to R&M 2000. Many things have been learned over the years. The C-5 aircraft included full R&M requirements at every level. R&M was addressed more from mission reliability rather than logistics reliability. Today, mission and logistics reliability receive attention. R&M 2000 provides upper level management support of R&M which is necessary. R&M 2000 will be effective in emphasizing R&M.

Question 11--Experienced personnel must be involved in development of criteria and standards. An inexperienced person developing criteria and standards should receive guidance from experienced personnel.

Appendix C: Personal Interview

Name: 1st Lt William Liberti
Organization: Reconnaissance and Electronic Warfare Systems, ASD/RWEX
Duty Title: R&M Engineer
Experience: Development of criteria and standards for SEEK RAM program.

Question 1--1st Lt Liberti was given little direction when tasked with developing R&M criteria and standards. Sources of reference included the SOW, specifications, previous contracts, MIL HDBK 217D, MIL STD 756, and experience of other personnel.

Question 2--A boiler plate type of outline was used for development of the R&M criteria. Portions of the boiler plate are included in the R&M guide, Appendix J. The R&M Maintenance concept can make one system unique from another. For the SEEK RAM, the contractor has the option of two or three levels of maintenance.

Question 3--The SOW and criteria should be developed at the same time. This helps provide consistency. Communication between R&M and Logistics should also take place to avoid duplication of requirements. R&M personnel are involved throughout RFP preparation and review.

Question 4--Requirements must not be too specific as to constrain the contractor. Requirements should be general enough to allow the contractor to develop an

effective R&M plan. There is a fine line between too specific and too general.

Question 5--A subjective weighting takes place. Certain factors and subfactors within the R&M item can be considered more important than others. R&M predictions often provide a good comparison among contractors as a contractor will be readily identified if predictions are not within the general range of the government estimate.

Question 6--R&M is considered as two separate items under the technical area. Prior to R&M 2000, R&M was as a factor under the performance item.

Question 7--Maintainability is difficult to evaluate as it is difficult to conceptualize on paper. It is difficult to determine if the design is the most efficient for maintainability. Under Reliability Task 102, monitoring of subcontractors, it is difficult to evaluate if the contractor's system will be effective. Reliability critical items are also difficult to evaluate. It is difficult to dispute what the contractor considers to be critical items. Budgeted growth curves are also difficult to evaluate as it is hard to determine if the entry point and slope are accurate. It is up to to the evaluator's judgement to determine.

Question 8--Contractors are reluctant to perform environmental stress screening at the parts level as they

claim the screening is done before they receive the part. The requirement was generally waived by the government.

Question 9--It has not been difficult to involve other personnel in R&M evaluation.

Question 10--R&M was not properly addressed in the sense that it was not taken seriously although it was a requirement. R&M 2000 is effective in emphasizing the importance of R&M to those outside of the R&M field.

Question 11--Personnel involved in development of R&M criteria and standards must keep in mind the ultimate R&M objectives of the program. The criteria and standards serve as the means of obtaining the objective.

Appendix D: Personal Interview

Name: William Lucka
Organization: Product Assurance, ASD/ENSI
Duty Title: Division Chief
Experience: Developing R&M criteria and standards.
Directing R&M policy to Program Offices.

Question 1--The major source of reference is the SOW. Along with the SOW, Mr. Lucka advised familiarity with MIL STD 785 as it provides guidance on the rationale for using particular R&M tasks. At times, previous contracts are used as a guide, however, fresh thinking must always be used. Criteria and standards should be developed with the frame of mind of what the government ultimately wants to achieve.

Question 2--There is no list of criteria and standards from which to choose. Criteria and standards are unique in respect to major weapon systems versus subsystems. There are similarities, however, major weapon system criteria and standards are more extensive.

Question 3--To insure development of criteria, the government should avoid having two R&M requirements; one under Technical and the other under Logistics. At times, Logistics personnel attempt to write R&M requirements without knowing the design process and do not coordinate with R&M engineers. This results in requirements being stated referencing specific types of equipment rather than

stating requirements in terms of performance. Logistics coordination is necessary, however, Product Assurance should have the main responsibility for developing R&M requirements with R&M under the Technical area.

Question 4--Personnel tend to be too specific and will tell the contractors how to design. Requirements should be stated clearly, unambiguously, not subject to interpretations, and not so specific as to tie contractors' hands in telling how to design. An example of misleading requirements is to specify that the system will be supported at two levels of maintenance; flight line and depot, when in fact, intermediate level of maintenance will also be provided.

Question 5--Standards are not specifically ranked, however, subjective ranking takes place. Certain standards are weighed stronger in determining whether or not the contractor has met the overall R&M requirements.

Question 6--R&M is being applied in source selection as the number one item under the technical area. Mr. Lucka is not aware of R&M consideration prior to R&M 2000.

Question 7--N/A. Not involved in recent source selection.

Question 8--A major problem is a lack of sufficient data submitted by contractors. Sufficient back up material is not submitted to substantiate R&M capability.

Question 9--It has not been difficult to involve personnel in source selections, however, it is often difficult after source selection to involve personnel.

Question 10--R&M was properly addressed prior to R&M 2000. There had been a push to increase R&M priority. R&M 2000 provided the attention necessary to increase the priority of R&M. R&M 2000 will be effective in emphasizing R&M.

Question 11--R&M may be better evaluated if operational terms could be directly correlated with contractual terms. It is often difficult to determine if operational requirements are satisfied even when all contractual requirements are fulfilled. An example of the difficulty would be an operational statement such as 95% probability of success of a one-and-a-half hour mission. In order to translate this requirement into contractual terms, several subsystem MTBF's and other measures must be combined.

Appendix E: Personal Interview

Name: Clay Nieman
Organization: Aeronautical Equipment, ASD/AEES, INU Program Office.
Duty Title: R&M Engineer
Experience: Involved in a number of system acquisitions developing R&M criteria and standards. Programs include: Locust missile, DADS, INU, among others.

Question 1--A major factor considered when developing R&M criteria and standards is the requirements in the SOW. Mr. Nieman creates a checklist of key R&M areas in the SOW with paragraph references. This insures that all necessary areas are addressed in the criteria. Criteria must indicate types of information that the government expects to be submitted in proposals. Contractors should not simply state that requirements can be met, they must state detailed plans and procedures for accomplishing the task.

Along with the referenced paragraphs, Mr. Nieman makes notes of what he expects to see in the proposals to insure the areas are adequately covered by the contractor in the proposal. This constitutes the standards used in the source selection.

A second factor considered is the phase of acquisition. Concept exploration has limited R&M tasking as system design is in preliminary stages, therefore, criteria and standards will be less comprehensive. Demonstration/

Validation has greater tasking. Tasking peaks at Full Scale Development as the design becomes finalized and decreases in production.

Mr. Nieman listed the following sources of reference that, as a minimum, personnel involved in development of criteria and standards should be familiar with:

DOD Directive 5000.40--Reliability and Maintainability
AFR 800-18--Air Force Reliability and Maintainability Program
MIL STD 785B--Reliability Program for Systems and Equipment Development and Production.
MIL STD 470A--Maintainability Program for Systems and Equipment.
MIL STD 756B--Reliability Modeling and Prediction
MIL HDBK 217D--Reliability
MIL STD 781C--Reliability Testing
MIL STD 1629A--FMECA
AS 4613--Derating Criteria
MIL HDBK 472--Maintainability Prediction
MIL STD 471A--Maintainability/Built-In-Test Demonstration
MIL STD 2165--Testability
MIL HDBK 338--Reliability
MIL HDBK 189--Reliability Growth Management
MIL STD 810--Environmental Test
MIL STD 883B--Electronic Component Testing
MIL STD 1635--Reliability Growth Standard
MIL HDBK 251--Thermal Analysis

Mr. Nieman stressed that criteria and standards must be tailored to each acquisition.

Question 2--Mr. Nieman did not indicate any available list of criteria and standards or key areas making a system unique. Once again, he stated that criteria and standards must be tailored. Mr. Nieman has compiled a comprehensive list of questions to be asked and areas to be

addressed in R&M criteria and standards. Portions of the list will be contained in Appendix J.

Question 3--To insure requirements in the SOW are stated in a way to allow development of criteria, the same person developing the SOW should also develop the criteria. This cannot always be accomplished due to PCSs and personnel shortages. R&M personnel are involved in RFP preparation and review.

Question 4--To improve stated requirements, adequate information must be contained in the instructions to offeror section to insure the proposal provides more than a restatement of the SOW.

Question 5--Reliability and Maintainability standards are equal in priority. Ranking is done at the area level.

Question 6--Mr. Nieman indicated that R&M is receiving attention at the factor level under the item technical specialties/product assurance. Previous to R&M 2000, technical specialties/product assurance was a factor and R&M was a subfactor. This indicates that R&M has moved up in priority.

Question 7--Future capability has been the most difficult R&M area to evaluate. When a contractor is proposing a system which will not be built for 5-10 years, a lot of judgement is required. Many uncertainties exist.

Question 8--Mr. Nieman has not run into recurring problems. If a contractor is non-responsive to an R&M requirement, it generally means that the contractor does not have the capability or requirements are not stated properly.

Question 9--It has not been difficult to involve other personnel in R&M evaluation. Generally, the following personnel are involved; systems engineering, Logistics, manufacturing, and cost analysis.

Question 10--R&M was properly addressed prior to R&M 2000, however, it did not receive the attention or priority. R&M 2000 will improve R&M, however, Mr. Nieman sees a manpower constraint in the future with a shortage of R&M engineers.

Question 11--Recommendations:

1. Increase the number of R&M engineers.

2. Provide more time for development of the SOW to insure proper criteria and standards can be developed.

3. Program Managers should be more thoroughly briefed on R&M.

Appendix F: Personal Interview

Name: Richard Papenbrock
Organization: Reconnaissance and Electronic Warfare, ASD/RWEX
Duty Title: Lead Engineer, Product Assurance
Experience: Developing criteria and standards for R&M. Responsible for 48 programs ranging from conceptual phase to production phase.

The eleven questions were not administered to Mr. Papenbrock as he provided an overview of the emphasis being placed on R&M within his organization. R&M is considered as an item under the technical area in source selection. R&M is considered as one item or broken out into two items; reliability and maintainability.

Upper level management attention is placed on R&M through the policy that Dr. Halpin, ASD/PA will be involved in all source selections. Mr. Papenbrock has developed an operating instruction, OI 800-8, Product Assurance Program, which integrates R&M, Logistics, quality, and related functional areas to more effectively influence the design and development process. This IO is being used within many SPOs at ASD.

Prior to R&M 2000, Mr. Papenbrock's office was accomplishing required R&M tasks along with initiating emphasis on R&M. Although R&M 2000 has provided the attention needed at higher levels, it has also increased workload in respect to reporting of R&M and involvement in various

meetings. These requirements are often necessary, however, additional R&M personnel are not being assigned to take on the additional workload.

Appendix G: Personal Interview

Name: Robert M. Read
Organization: AFALC/PTRR
Duty Title: R&M Engineer
Experience: Developing criteria and standards for the Automated Remote Tracking System. Evaluated R&M for the Advanced Tactical Fighter in Conceptual Phase.

Question 1--The SOW and specifications are the main references used in developing evaluation criteria contained in the Instructions to Offeror (ITO). In developing standards, only those requirements in the ITO can be evaluated against specific standards. MIL STD 785B and MIL STD 470 are basic references that personnel should be familiar with when developing R&M criteria and standards.

Question 2--A list of criteria and standards did not exist, however, certain criteria were used after tailoring them for the specific system. A consideration which makes one system unique from another is whether the system is more mechanical or electrical. SOW requirements must be written to accommodate this difference. R&M test plan requirements, for example, will be different for a mechanical system versus an electrical system. Each system acquisition is unique, therefore, criteria and standards must be written to reflect the differences among systems.

Question 3--Requirements should be explicit and clearly identify to the contractor what is to be achieved. The contractor should not be told how to design. R&M

personnel are involved throughout RFP preparation and review to insure that R&M requirements do not conflict with other requirements in the RFP.

Question 4--R&M tasks must be tailored to the specific system. At times, tasks are taken from the military standards and not tailored. This causes difficulty in developing standards to evaluate R&M capability for a specific system.

Question 5--Mr. Read has not observed ranking of standards, however, ranking should take place as certain R&M requirements are more critical than others.

Question 6--R&M is currently the number one item under the technical area. R&M has been moving up in priority over the past few years. Prior to R&M 2000, R&M was considered as a factor or subfactor.

Question 7--Evaluation of R&M predictions is an easier area to evaluate. Although calculations are required to verify proposed predictions, there are specific areas to check.

Comparability analysis in the conceptual phase of acquisition is difficult. The analysis is subjective and deals with determining future capability and technology compared to that existing today.

Question 8--A recurring problem is a lack of sufficient data submitted with proposals. Contractors do not support stated R&M capability.

Question 9--Prior to the current emphasis on R&M, it was difficult to involve other personnel. Today it is not difficult.

Question 10--R&M was being properly addressed, however, R&M 2000 provided the necessary upper level management support to increase the priority of R&M. R&M 2000 is being effective in emphasizing R&M in source selection.

Question 11--Personnel must insure that requirements in the SOW and specifications are clearly written as these serve as the basis for development of criteria and standards.

Appendix H: Personal Interview

Name: 1st Lt Michael Secen
Organization: AFALC/PTRR
Duty Title: R&M Engineer
Experience: Developing R&M criteria and standards for the Integrated Electronic Warfare System, EF-111A upgrade, and others.

Question 1--The SOW is the main source of reference. A major reference is also MIL STD 785B. A reliability design checklist developed by the U.S. Navy is also utilized.

Question 2--A list of criteria and standards is not available. 1st Lt Secen is not aware of areas that make one system unique from another.

Question 3--R&M personnel are involved in RFP preparation. Requirements should be written in general terms. AFALC interfaces with Product Assurance to incorporate logistics concerns into R&M requirements.

Question 4--To improve development of standards, standards should be written when the RFP is prepared. Difficulty arises in developing standards when the same person developing the RFP SOW is not involved in developing standards. Having the same individual develop standards provides consistency in development. An individual's experience on a particular system will not be lost.

Question 5--Ranking of standards takes place through subjective ranking by the evaluators. A formalized ranking is not established.

Question 6--R&M is being pushed as the number one item under the technical area. R&M was previously considered at the factor or subfactor level.

Question 7--It is difficult to evaluate proposals in the conceptual phase of acquisition as requirements are vague. Contractor past performance on R&M requirements is also difficult to evaluate as little information is provided in source selection on past performance. Evaluation is less difficult during the full scale development and production phases as specific tasks and requirements are identified and evaluators know what the contractor needs to provide to show R&M capability.

Question 8--Problems arise with source selection management when guidance is changed in regards to required documentation. Management is not always familiar with R&M requirements in source selection.

Question 9--Personnel have generally been involved in their own areas. R&M has received adequate support.

Question 10--R&M was emphasized prior to R&M 2000, however, R&M 2000 provides the needed emphasis from upper level management. R&M 2000 will be effective in emphasizing R&M in source selection.

Question 11--Standards should be written before release of the RFP. Source selection management should become more aware of R&M requirements prior to conducting a source selection.

Appendix I: Personal Interview

Name: Gene Wolanski
Organization: Product Assurance, ASD/ENSI
Duty Title: R&M Engineer
Experience: Involved in development of R&M criteria and standards for subsystems such as modular automatic test equipment, ground power generator, towbar, and others.

Question 1--Criteria and standards are developed from the SOW. Format from previous contracts is generally used, however, criteria and standards must be tailored for each acquisition.

Question 2--There is no list of criteria and standards. Certain criteria and standards are taken from previous contracts and tailored. Management generally provides guidance as to the appropriateness of standards.

Question 3--Personnel developing the SOW must not provide too much detail in the requirements and thereby influence the design of the system. R&M personnel are involved in RFP preparation to help insure properly stated requirements.

Question 4--A format to follow in developing standards would be useful. Requirements could be cross-referenced to the standards format to insure all areas are covered. Specific standards, however, cannot be developed until the SOW and criteria are developed.

Question 5--Standards have received equal ranking.

Question 6--R&M is being applied as an item under the technical area. R&M was previously treated as a factor.

Question 7--The R&M plan has been the easiest area to evaluate. Evaluating data submitted is the most difficult area as you must determine if the data is reasonable or makes sense.

Question 8--A recurring problem involves a lack of sufficient data submitted with proposals. There is also, at times, a lack of technical understanding by the contractor.

Question 9--Other personnel have been involved in R&M evaluation. The degree to which personnel are involved depends on the particular source selection (size of the program).

Question 10--Prior to R&M 2000, the degree to which R&M was emphasized in source selection was dependent upon the source selection management. At times, program pressure caused R&M requirements to be loosened. An example of this would be a decision to verify R&M on paper rather than through demonstration due to pressure to decrease program costs. R&M 2000 will be effective in emphasizing R&M as higher level attention is placed on R&M.

Question 11--More guidance in the form of checklists or examples would improve the development of criteria and standards.

Appendix J: Guide for Development of Source Selection Evaluation Criteria and Standards for Reliability and Maintainability

This guide was established to aid personnel in the development of source selection evaluation criteria and standards for reliability and maintainability.

GUIDE FOR DEVELOPMENT OF SOURCE SELECTION EVALUATION CRITERIA AND STANDARDS FOR RELIABILITY AND MAINTAINABILITY

Captain Daniel E. Harnen, Jr.

Air Force Institute of Technology

Wright-Patterson Air Force Base

September 1985

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GUIDE FOR DEVELOPMENT OF SOURCE SELECTION EVALUATION CRITERIA AND STANDARDS FOR RELIABILITY AND MAINTAINABILITY

Introduction

Reliability and Maintainability (R&M) issues have become the prime focus of attention within the Air Force in the development and acquisition of major weapon systems. A weapon system must be able to perform with consistent reliability and be designed for efficient and effective maintainability.

The source selection process is the avenue through which major weapon systems are brought into the Air Force inventory. Proper evaluation R&M in the source selection process is imperative to insure the most reliable and maintainable weapon systems are acquired.

This guide provides general procedures to follow when developing source selection evaluation criteria and standards for R&M. The guide is not intended as a detailed step-by-step procedure for development of evaluation criteria and standards for a particular weapon system or phase of the acquisition process. Each acquisition is unique, therefore, general guidance is provided which may be applied to various acquisitions.

A number of examples of evaluation criteria and standards for R&M are provided in the guide. Although the examples may not specifically apply to the system being acquired by the users of this guide, they do illustrate effective ways to state various R&M requirements. The examples should be tailored to the particular system being acquired. Also contained in the guide is a list of questions that evaluators may use to support and clarify various R&M standards. The questions relate to the Reliability Program Plan, Maintainability Program Plan, Built-InTest (BIT), and Reliability Testing. Finally, the guide identified R&M areas that are easier and more difficult to evaluate.

Evaluation Criteria Defined

AFR 70-15 defines evaluation criteria as the basis for measuring each offeror's ability as expressed in its proposal, to meet the government's needs as stated in the solicitation. Evaluation criteria must be included in the solicitation and must be tailored to each program.

Evaluation criteria consist of specific and assessment criteria that provide a matrix which identifies and interrelates what is to be evaluated. Figure 1 provides an example of a general format for matrix of evaluation criteria.

Specific criteria relate to program characteristics and include areas of evaluation. Areas of evaluation are subdivided into items, factors, and at times, subfactors. The level of subdivision depends on the complexity of the area being evaluated. Typical areas include; technical, logistics, manufacturing, operational utility, test, and management. Within the technical area, for instance, R&M is considered as the number one item to be evaluated. Assessment criteria relate to the offeror's proposal and abilities and may be ranked in order of relative importance. Assessment criteria normally include the following:

1. Soundness of technical approach
2. Understanding of the requirement
3. Compliance with the requirement
4. Past performance
5. Impact on the schedule.

Figure 2 provides a visual representation of the relationship between areas, items, and factors. The figure also portrays the increased emphasis being placed on reliability, maintainability, and producibility by moving these considerations from factors to an item. Criteria must instruct offerors to demonstrate thoroughly and precisely in their proposals how reliability, maintainability, and producibility are weighed in the design of the system.

GENERAL FORMAT FOR MATRIX OF EVALUATION CRITERIA
AREA
(Technical, Logistics, Test, Management, etc.)

Specific Criteria / Assessment Criteria	Item 1 Description		Item 2 Description		Item 3 Description	Item 4 Description
	Factor 1	Factor 2	Factor 1	Factor 2		
Soundness of Approach	COLOR	COLOR	COLOR	COLOR		
Understanding of Requirement						
Past Performance						
Compliance with Requirement						
Other Assessment Criteria						

NOTES:
1. If a factor is displayed graphically it must be color coded.
2. If one factor for an item is displayed, all factors for all items within the area must be displayed.

Fig. 1. Matrix of Evaluation Criteria

SOURCE SELECTION EVALUATIONS

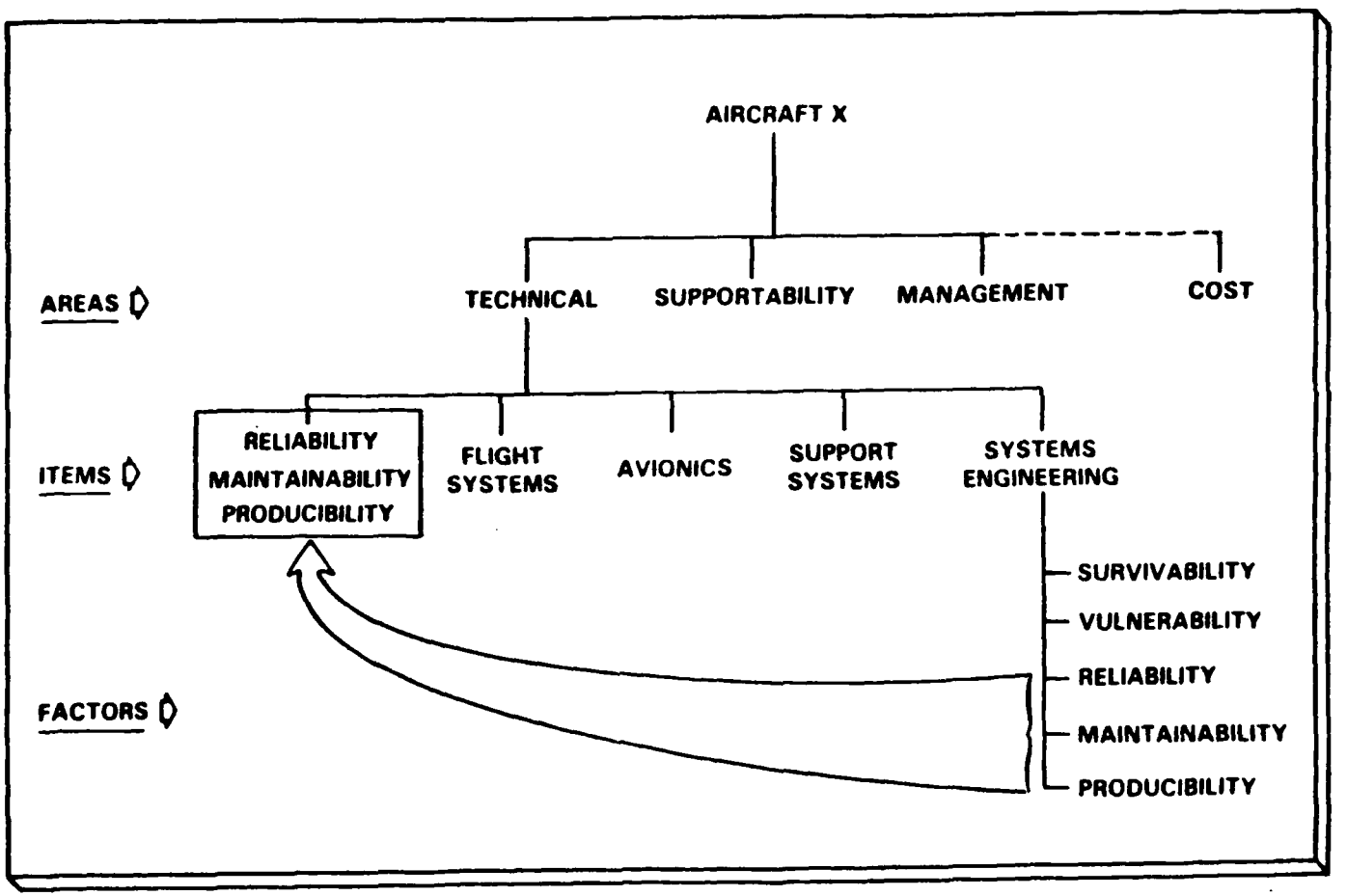

Fig. 2. Source Selection Evaluations

Evaluation Standards Defined

According to AFR 70-15, evaluation standards establish the minimum acceptable level of compliance with a requirement that must be offered for a proposal to be considered acceptable. Standards may be either quantitative or qualitative depending on the factor or subfactor they address. Standards are also used for measuring how well each offeror's approach meets the requirements and to determine when an offeror fails to meet requirements, or exceeds requirements.

Standards are not included in the solicitation and are not to be released to any potential offeror or personnel not directly involved in the source selection. Safeguarding of standards is required to prevent offerors from obtaining an unfair advantage through receiving standards prior to submission of proposals. After contract award, standards relating to a specific contract are safeguarded to help prevent disputes arising from offerors who did not receive the contract and who may seek to refute specific standards.

References Used When Developing Criteria and Standards

In developing criteria and standards, the basic source of reference is the Statement of Work (SOW). The SOW establishes the requirements of the Request for Proposal (RFP). In order to evaluate contractors based on

certain requirements, the requirements must be expressed in the evaluation criteria and contained in Section L of the RFP, Instructions to Offeror (ITO).

Previous contracts may be used as a reference, depending on the similarity among systems being acquired. In some instances only the format from the previous contracts may be used, whereas in others, only minor changes may be necessary in order to use the criteria and standards. Regardless of the degree of similarity between systems, previous contract criteria and standards if used as a reference must always be tailored to the system being acquired.

The experience of others may also be used as a reference. On the surface, this may seem a subtlety, however, it is often under utilized. Given the large number of diverse programs within the Air Force, a wealth of knowledge exists which less experienced personnel should take advantage of when developing criteria and standards.

Several Military Standards and Handbooks on R&M are available. The Standards and Handbooks provide detailed guidance on particular R&M tasks and requirements. As a minimum, personnel should be familiar with the following references:

DOD Directive 5000.40--Reliability and Maintainability
AFR 800-18--Air Force Reliability and Maintainability Program

MIL STD 785B--Reliability Program for Systems and Equipment Development and Production.
MIL STD 470A--Maintainability Program for Systems and Equipment.
MIL STD 756B--Reliability Modeling and Prediction
MIL STD 781C--Reliability Testing
MIL STD 1629A--FMECA
MIL STD 471A--Maintainability/Built-In-Test Demonstration
MIL STD 2165--Testability
MIL STD 810--Environmental Test
MIL STD 883B--Electronic Component Testing
MIL STD 1635--Reliability Growth Standard
AS 4613--Derating Criteria
MIL HDBK 217D--Reliability
MIL HDBK 472--Maintainability Prediction
MIL HDBK 338--Reliability
MIL HDBK 189--Reliability Growth Management
MIL HDBK 251--Thermal Analysis

Stating Requirements for Criteria Development

R&M personnel must be involved throughout RFP preparation and review to insure R&M requirements are properly stated.

To allow for development of criteria, requirements in the SOW should be stated in general terms without detail to the extent of influencing the contractor's design. Also, the same person developing the SOW should also develop the criteria and standards. This provides for consistency of thought and allows for development of criteria and standards by an individual with full knowledge and background of the SOW requirements.

Requirements should be stated in commercial terms to allow contractors with less experience in government work to be able to understand the requirements. This would help

in development of standards as contractors are less likely to be non-responsive to certain RFP requirements.

At times, R&M requirements are stated in both the technical and logistics areas. However, R&M should only be stated in one of the areas, preferably technical to avoid a conflicting statement of requirements.

Requirements should not influence or restrict the options of the designer during the conceptual and demonstration/validation phases. Therefore, the particular phase in the acquisition process should also be considered when developing SOW requirements.

Stating Requirements for Standards Development

Standards are essentially used to determine whether or not the contractor has satisfied the requirements stated in the evaluation criteria in the RFP. Criteria must be stated in such a way that contractors submit justification and data to support their ability to perform the various requirements. Contractors must not simply restate the SOW. Standards are developed to judge the ability of the contractor to meet the criteria.

As with development of criteria, requirements in the SOW must not be too specific. They must be stated clearly and unambiguously. There is a fine line between too specific and too general, however, the design process must not be inhibited.

R&M tasks must be tailored to the specific system. At times, tasks are incorporated into the RFP and not tailored. This causes difficulty in developing standards to evaluate R&M capability for a specific system.

Development of Evaluation Criteria for R&M

Properly stated evaluation criteria are one of the most important elements of the source selection process because only those areas stated as evaluation criteria in the Request for Proposal (RFP) can be evaluated in the source selection. The evaluation criteria are contained in the Instructions to Offeror (ITO) section of the RFP and are intended to inform the offeror of areas that will be evaluated during source selection. Improperly stated or inadequate evaluation criteria, therefore, can seriously affect the source selection process. In order to insure that the contractor with the most reliable and maintainable weapon system is chosen in source selection given cost considerations; evaluation criteria must be properly stated.

Proper statements of evaluation criteria will include all critical R&M requirements from the Statement of Work (SOW) and specifications. Evaluation criteria should not simply be a restatement of all SOW and specification requirements. It is up to the individual developing

criteria to choose critical R&M requirements. When stating criteria, personnel must avoid language which restricts the contractor's freedom to design the most reliable and maintainable system.

Development of criteria should be considered as a systematic process which begins with familiarity of the SOW and specifications. When developing criteria, personnel should keep in mind the overall objectives of the weapon system R&M and develop criteria to meet these objectives. Offerors must be instructed to demonstrate how each R&M task will be accomplished. Offerors must also be required to submit data to support proposed R&M capability. Receipt of adequate data to support R&M capability cannot be overemphasized. For example, at time offerors simply state that R&M requirements in the SOW will be met, however, they do not provide supporting data to show the capability to meet the requirements.

The particular phase in the acquisition process must also be considered when developing evaluation criteria. In the conceptual phase of acquisition, detailed R&M needs are usually impractical to define, especially below the system level. However, based on threat analysis, force planning and budgeting information, and R&M shortcomings of current systems, top level R&M needs can be defined. Evaluation criteria, however, will not be extensive in the conceptual phase. R&M requirements increase during the demonstration/

validation phase and generally peak at full scale development as the system design is completed. Evaluation criteria in the full scale development phase must adequately reflect the increased R&M requirements in the SOW. In the production phase, R&M requirements slightly decrease, however, new tasks may be added due to changes in design. Therefore, evaluation criteria must be written to reflect the particular phase of acquisition.

To illustrate the relationship between the phase of acquisition and degree of R&M tasking, Tables I and II, Application Matrix for Reliability and Application Matrix for Maintainability, provide personnel involved in RFP preparation with guidance as to reliability and maintainability tasks which should be included during various stages of acquisition. The particular tasks selected will depend on the system being acquired and phase of acquisition. As can be seen, few requirements are applicable during concept exploration while at full scale development, generally all tasks are applicable. R&M tasking decreases during production.

The size of the particular program will impact development of evaluation criteria. Generally, for a major weapon system acquisition versus a subsystem acquisition, criteria will be much more elaborate due to the greater amount of R&M requirements in the SOW and specifications. For a subsystem acquisition, evaluation criteria will

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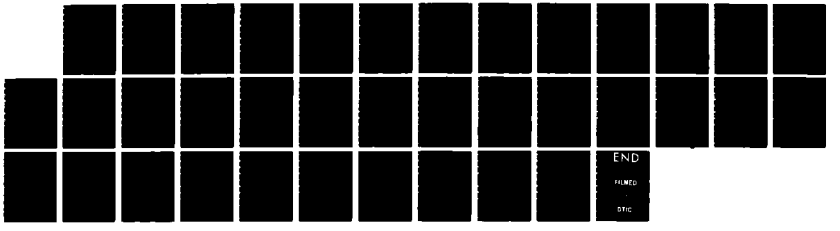

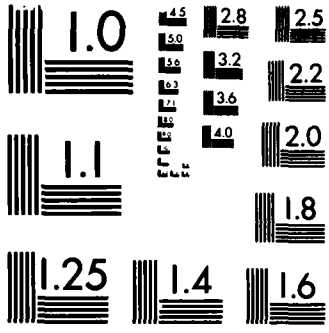

MICROCOPY RESOLUTION TEST CHART
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Table I

Reliability Application Matrix

TASK	TITLE	TASK TYPE	PROGRAM PHASE			
			CONCEPT	VALID	FSED	PROD
101	RELIABILITY PROGRAM PLAN	MGT	S	S	G	G
102	MONITOR/CONTROL OF SUBCONTRACTORS AND SUPPLIERS	MGT	S	S	G	G
103	PROGRAM REVIEWS	MGT	S	S(2)	G(2)	G(2)
104	FAILURE REPORTING, ANALYSIS, AND CORRECTIVE ACTION SYSTEM (FRACAS)	ENG	NA	S	G	G
105	FAILURE REVIEW BOARD (FRB)	MGT	NA	S(2)	G	G
201	RELIABILITY MODELING	ENG	S	S(2)	G(2)	GC(2)
202	RELIABILITY ALLOCATIONS	ACC	S	G	G	GC
203	RELIABILITY PREDICTIONS	ACC	S	S(2)	G(2)	GC(2)
204	FAILURE MODES, EFFECTS, AND CRITICALITY ANALYSIS (FMECA)	ENG	S	S (1)(2)	G (1)(2)	GC (1)(2)
205	SNEAK CIRCUIT ANALYSIS (SCA)	ENG	NA	NA	G(1)	GC(1)
206	ELECTRONIC PARTS/CIRCUITS TOLERANCE ANALYSIS	ENG	NA	NA	G	GC
207	PANTS PROGRAM	ENG	S	S(2)(3)	G(2)	G(2)
208	RELIABILITY CRITICAL ITEMS	MGT	S(1)	S(1)	G	G
209	EFFECTS OF FUNCTIONAL TESTING, STORAGE, HANDLING, PACKAGING, TRANSPORTATION, AND MAINTENANCE	ENG	NA	S(1)	G	GC
301	ENVIRONMENTAL STRESS SCREENING (ESS)	ENG	NA	S	G	G
302	RELIABILITY DEVELOPMENT/GROWTH TESTING	ENG	NA	S(2)	G(2)	NA
303	RELIABILITY QUALIFICATION TEST (RQT) PROGRAM	ACC	NA	S(2)	G(2)	G(2)
304	PRODUCTION RELIABILITY ACCEPTANCE ACCEPTANCE TEST (PRAT) PROGRAM	ACC	NA	NA	S	G(2)(3)

CODE DEFINITIONS

TASK TYPE:

ACC - RELIABILITY ACCOUNTING

ENG - RELIABILITY ENGINEERING

MGT - MANAGEMENT

PROGRAM PHASE

S - SELECTIVELY APPLICABLE

G - GENERALLY APPLICABLE

GC - GENERALLY APPLICABLE TO DESIGN CHANGES ONLY

NA - NOT APPLICABLE

(1) - REQUIRES CONSIDERABLE INTERPRETATION OF INTENT TO BE COST EFFECTIVE

(2) - MIL-STD-785 IS NOT THE PRIMARY IMPLEMENTATION REQUIREMENT. OTHER MIL-STDS OR STATEMENT OF WORK REQUIREMENTS MUST BE INCLUDED TO DEFINE THE REQUIREMENTS.

Table II

Maintainability Application Matrix

	TASK TITLE	TASK TYPE	PROGRAM PHASE				
			CON-CEPT	VALID	FSD	PROD	OPERAT SYSTEM DEV (MODS)
101	Maintainability Program Plan	MGT	N/A	G(3)	G	G(3)(1)	G(1)
102	Monitor/Control of Sub-contractors and Vendors	MGT	N/A	S	G	G	S
103	Program Reviews	MGT	S	G(3)	G	G	S
104	Data Collection, Analysis and Corrective Action System	ENG	N/A	S	G	G	S
201	Maintainability Modeling	ENG	S	S(4)	G	C	N/A
202	Maintainability Allocations	ACC	S	S(4)	G	C	S(4)
203	Maintainability Predictions	ACC	N/A	S(2)	G(2)	C	S(2)
204	Failure Modes and Effects Analysis (FMEA) Maintainability Information	ENG	N/A	S(2) (3)(4)	G(1) (2)	C(1) (2)	S(2)
205	Maintainability Analysis	ENG	S(3)	G(3)	G(1)	C(1)	S
206	Maintainability Design Criteria	ENG	N/A	S(3)	G	C	S
207	Preparation of Inputs to Detailed Maintenance Plan and Logistics Support Analysis (LSA)	ACC	N/A	S(2) (3)	G(2)	C(2)	S
301	Maintainability Demonstration (MD)	ACC	N/A	S(2)	G(2)	C(2)	S(2)

CODE DEFINITIONS

S - Selectively applicable

G - Generally Applicable

C - Generally Applicable to design changes only

N/A - Not applicable

ACC - Maintainability Accounting

ENG - Maintainability Engineering

MGT - Management

(1) Requires considerable interpretation of intent to be cost effective.

(2) MIL-STD-470 is not the primary implementation document. Other MIL-STDS or Statement of Work requirements must be included to define or rescind the requirements. For example MIL-STD-471 must be imposed to describe maintainability demonstration details and methods.

(3) Appropriate for those task elements suitable to definition during phase.

(4) Depends on physical complexity of the system unit being procured, its packaging and its overall maintenance policy.

generally be less involved as fewer requirements will be contained in the SOW and specifications. The following two examples illustrate fairly elaborate R&M criteria which may be tailored to a major weapon system acquisition:

Elaborate Criteria

Example 1:

Reliability and Maintainability. Describe your approach for assuring that the specified reliability and maintainability (R&M) requirements will be met. Show how you will allocate reliability and identify reliability critical items, for example, the radar transmitter [insert critical items peculiar to the system being acquired]. For all subsystems, present preliminary R&M allocations, models, and predictions down to the Line Replaceable Unit (LRU) level [Insert level for given acquisition] giving series and mission mean-time-between-failures as defined in the System Specification, and mean and maximum maintenance times. Identify sources of data including demonstrated reliability for LRUs that are production derivative hardware. Provide sample calculations for mission reliability and describe the impact of and sensitivity to the acceptable performance levels defined in the System Specification. Describe all redundancy and system monitoring, failure detection/isolation, and built-in-test (BIT/BITE) capabilities, your Failure Reporting, Analysis and

Corrective Action System (FRACAS), subcontractor/vendor controls and monitoring, identification and control of critical items, and environmental stress screening program.

Example 2:

Reliability/Maintainability. The offeror shall provide R&M discussion and data, as outlined below, as part of the technical proposal.

1. Preliminary R&M program plans, which itemize and discuss each task which will be performed, shall be submitted with the technical proposal. These plans shall also include:

a. An organizational chart and explanation of the management structure and emphasis that insure accomplishment of R&M tasks.

b. A discussion of the R&M engineering role relative to design decisions, program visibility and contribution to the overall program.

2. Discuss in detail the design features and techniques utilized to achieve compliance with R&M requirements.

3. Provide preliminary R&M predictions with detailed discussions of:

a. The methods and conditions used in the predictions.

b. The testing to be performed.

c. The data items to be provided.

d. A discussion of high risk areas and their program impacts and potential solutions.

e. The failure reporting, analysis, and corrective action system used.

f. R&M concepts.

g. Analyses to be performed and their potential benefits.

h. The preliminary reliability predictions shall indicate the expected laboratory and field system and subsystem reliability indices in terms of Mean Time Between Failure (MTBF) and Mean Flying Time Between Maintenance (MTBM) (Inherent) and (Total) and Mean time Between Removal (MTBR) (which relates to MTBM (Total)) as defined in AFR 800-18, respectively. The preliminary maintainability predictions shall indicate the expected LRU and SRU maintainability indices in manhours per flying hour and Mean-Time-To-Repair (MTTR) at each level.

4. Discuss in detail the design features and techniques used to achieve Built-In-Test (BIT) confidence requirements. Include a preliminary BIT confidence prediction.

5. Automatic Test Equipment being proposed by the offeror to support his proposed system shall be discussed in detail, including:

a. Fault isolation capability.

b. The specific level of indenture within the LRU being tested.

6. Discuss any other support equipment and/or Government Furnished Equipment (GFE).

Boiler Plate Criteria

The following example may be tailored to a subsystem acquisition. The criteria are in a "boiler plate" format and require only the applicable paragraph from The SOW.

Example:

Reliability Program. The offeror shall document a plan of the proposed reliability program including Growth Curves. The reliability program plan shall identify, describe, and tie together those reliability program components described in paragraph 101.2 of Task 101 of MIL STD 785B as tailored to the particular needs of this program by the Statement of Work Paragraph ____.

Maintainability Program. The offeror shall document a plan of the proposed maintainability program. The maintainability program shall identify, describe, and tie together those maintainability program components described in paragraph 101.2 of Task 101 of MIL STD 470A as tailored to the particular needs of this program by the Statement of Work paragraph ____.

Development of Source Selection Standards for R&M

Only those requirements stated within the evaluation criteria can be used to evaluate offerors in source selection. Therefore, source selection standards must be developed directly from the evaluation criteria. Standards are established to judge whether or not the offeror has met the requirements stated in the evaluation criteria. In order to accomplish this, standards are tied to specific requirements in the SOW and specification from which the evaluation criteria were developed.

The following basic format and categories are used in several examples shown in this guide and may be used by personnel developing standards:

AREA: [Indicate down to the
ITEM: level for which the
FACTOR: standard applies.]
SUBFACTOR:

DESCRIPTION: [Describe the particular Item, Factor or Subfactor to be evaluated.]

STANDARD: This standard is met when -

[Indicate those requirements from the RFP SOW, and specifications that the evaluator will look for in the offeror's proposal to determine if the standard is met.]

Examples of R&M standards contained in this guide provide effective wording and critical R&M requirements that must be shown in an offeror's proposal to demonstrate the particular R&M capability. The examples should be tailored to the system being acquired by the user of this guide. The examples are also useful in providing foresight to those involved in developing an R&M SOW, and evaluation criteria as any critical R&M requirement in a standard must also be included in the RFP. As stated earlier, standards are tied directly to the evaluation criteria, SOW, and specifications. Therefore, if critical R&M requirements are not included in these areas, they may not be used as source selection standards.

The examples in the guide do not reflect R&M as an item under the technical area as current guidance suggests. Programs utilizing the current emphasis of R&M as the number one item under the technical area are so new that standards were unavailable as they are treated as source selection sensitive. This in no detracts from the usefulness of the examples as they include R&M requirements which must be demonstrated by the offeror whether R&M is treated as an item, factor or subfactor.

The following examples illustrate elaborate R&M standards which may be tailored to a major weapon system acquisition.

Elaborate Standards

Example 1:

AREA: Technical

ITEM: Functional Programs

FACTOR: Reliability--This factor addresses the engineering tasks required for the reliability program at the item level.

STANDARDS: The offeror's technical proposal, with respect to reliability, will be technically acceptable when the following standards are met:

1. The offeror shows a clear understanding of the reliability program requirements, including program plan, reliability predictions, reliability allocation, demonstration of MTBM through operational verification, and a meaningful failure control program. The offeror identifies in a clear manner any problems associated with the reliability program.

2. The offeror outlines his approach to a logical and practical reliability program which covers the required aspects of reliability, such as an approach to the overall reliability program, scope of program to include reliability predictions, allocations, demonstration, and failure control. Identifies any STDs/HDBKs/etc., to be used as an aid in meeting SOW/TRD requirements and shows, in general, how the STDs/HDBKs/etc., will be used in the area of reliability predictions and allocations.

3. The offeror shows in clear and concise manner that the proposed reliability program complies with the requirements of the SOW/TRD/DIDs.

Example 2:

AREA: Technical

ITEM: Functional Programs

FACTOR: Maintainability--This factor addresses the engineering tasks required for the maintainability program at the item level.

STANDARDS: The offeror's technical proposal, with respect to maintainability, will be technically acceptable when the following standards are met:

1. The offeror shows a clear understanding of the maintainability program requirements, including a program plan to insure that MTTR requirements will be met, a satisfactory method for predicting item MTTR, allocation of MTTR requirements, and a demonstration technique for proving compliance with MTTR requirements. Also, the offeror outlines in a clear manner a method of resolving any problems which could arise as work progresses in the maintainability area.

2. The offeror outlines his approach to a logical and practical maintainability program which covers the required aspects of maintainability, including an approach to the overall maintainability program, what handbooks and

other aids will be used for MTTR prediction, how these aids will be used, how partitioning may be used to allocate MTTR to stay within TRD values, and also their approach to demonstrating the MTTR requirements.

3. The offeror shows in a clear and concise manner that the proposed maintainability program complies with the requirements of the SOW/TRD/DIDs.

Example 3:

Reliability. Description: This factor addresses the engineering tasks required for the reliability program at the item level.

Approach: The offeror outlines his approach to a logical and practical reliability program which covers the required aspects of reliability, such as an approach to the overall reliability program, scope of program to include reliability predictions, allocations, demonstration, and failure control. Identifies any STDs/HDBKs/etc., to be used as an aid in meeting SOW/TRD requirements and shows, in general, how the STDs/HDBKs/etc., will be used in the area of reliability predictions and allocations.

This standard is met when:

1. The offeror identifies a satisfactory organization to implement and complete the reliability program tasks (including experienced personnel).

2. The offeror outlines a sound reliability program per applicable MIL STDs.

3. The offeror identifies satisfactory STDs/HDBKs/ etc., to assist the following:

a. Prediction techniques

b. Allocation to SRU

c. Demonstration requirement

d. Failure assessment.

4. The offeror outlines a sound approach to demonstrating MTBM from "first test" through "IOT&E."

5. The offeror outlines a sound approach to detecting, reporting and analyzing/correcting pattern failures.

Compliance: The offeror shows in a clear and concise manner that the proposed reliability program complies with the requirements of the SOW/TRD/DIDs.

This standard is met when:

1. The offeror's proposal complies with the major aspects of the assignment, evaluation, and demonstration of reliability requirements.

2. The offeror provides a preliminary plan for the proposed reliability program which complies with the respective SOW/TRD paragraph requirements. These include:

a. Reliability predictions

b. Reliability allocation

c. Reliability demonstration

d. Failure reporting mechanism

Understanding: The offeror shows a clear understanding of the reliability program requirements, including program plan, reliability predictions, reliability allocation, demonstration of MSBM through operational verification and a meaningful failure control program. The offeror identifies in a clear manner any problems associated with the reliability program.

This standard is met when:

1. The offeror shows an adequate plan for insuring that reliability program plan requirements are met. This includes discussing the relationship between elements, such as:

a. Reliability predictions

b. Reliability allocations

c. Reliability demonstrations

d. Failure of equipment/correction.

2. The offeror shows a good understanding of how various data sources and experience with reliability prediction techniques are used to develop reasonable predictions that can be met by the type of equipment selected/ identified.

3. The offeror understands the level of effort necessary to assess the impact of various tradeoffs on system/ LRU reliability.

4. The offeror addresses the adequacy of schedules/plans/programs dealing with reliability, including the major factors that typically limit a viable reliability program.

Example 4:

Maintainability. Description: This factor addresses the engineering tasks required for the maintainability program at the item level.

Approach: The offeror outlines his approach to a logical and practical maintainability program which covers the required aspects of maintainability, including an approach to the overall maintainability program, what handbooks and other aids will be used for MTTR prediction, how these aids will be used, how partitioning may be used to allocate MTTR to stay within TRD values, and also their approach to demonstrating the MTTR requirements.

This standard is met when:

1. The offeror identifies an organization which should adequately handle the maintainability program, including experienced personnel.

2. The offeror outlines a sound maintainability program per applicable MIL STDs. This includes corrective/preventive maintenance, servicing, tools, test equipment, and skilled personnel.

3. The offeror has proposed to use satisfactory STDs/HDBKs/etc., to scope maintainability in the following areas:

a. MTTR predictions

b. MTTR allocation to SRU

c. Demonstration requirement.

4. The offeror shows a sound approach to demonstrating maintainability requirements, through verification of maintainability parameters (e.g., M_{ct}, M_{pt}, etc.).

5. The offeror shows adequate schedules/plans/programs dealing with the maintainability area, including any major factors that typically limit a viable maintainability program.

Compliance: The offeror shows in a clear and concise manner that the proposed maintainability program complies with the requirements of the SOW/TRD/DIDs.

This standard is met when:

1. The offeror's proposal complies with all major elements of maintainability from prediction through demonstration.

2. The offeror provides a preliminary plan for the proposed maintainability program which complies with the respective SOW/TRD paragraph requirements.

a. Maintainability predictions and allocation

b. Maintainability analysis

c. Maintainability demonstration

d. MTTR and preventive maintenance values

e. Interface between maintainability requirements and maintenance levels/tools/test equipment/ personnel/etc.

Understanding: The offeror shows a clear understanding of the maintainability program requirements, including a program plan to insure that MTTR requirements will be met, a satisfactory method for predicting item MTTR, allocation of MTTR requirements, and a demonstration technique for proving compliance with MTTR requirements. Also, the offeror outlines in a clear manner a method of resolving any problems which could arise as work progresses in the maintainability area.

This standard is met when:

1. The offeror shows an adequate plan for insuring that maintainability program plan requirements are met. This includes discussing the relationship between elements such as:

a. MTTR predictions

b. MTTR allocation

c. Maintainability demonstration

d. Maintenance levels

e. Corrective and preventive maintenance.

2. The offeror understands the need for, and has identified satisfactory data sources to assist in making reasonable maintainability predictions.

3. The offeror proves his understanding of maintainability tradeoffs through item partitioning, as related to the maintenance levels.

4. The offeror understands the procedures involved in conducting a maintainability demonstration and of the responsibilities of government and contractor in performing the demonstration.

Specific Standards

The following R&M standards address specific aspects of R&M and utilize various references to SOW paragraphs which the offeror must comply with in order to meet the standards. The user of this guide must tailor specific SOW paragraphs.

Example 1:

AREA: Technical

ITEM: T.1 System Design/Performance

FACTOR: T.1.19 Maintainability/Testability

DESCRIPTION: This factor involves the review of the BITE, Testability, Test points, and accessibility of the design.

STANDARDS: The standards will be met when the offeror indicates compliance with the following areas:

1. Maintainability design Specification paragraph 3.2.4.2

2. Test points Specification paragraph 3.2.4.2.1

3. Accessibility Specification paragraph 3.2.4.2.2

4. BIT Specification paragraph 3.2.4.2.3 and 3.2.4.2.3.1

5. Skill level paragraph 3.2.4.3.

Example 2:

AREA: Technical

ITEM: T.1 System Design/Performance

FACTOR: T.1.18 Reliability Prediction

DESCRIPTION: This factor involves the review of the offeror's reliability prediction.

STANDARDS: The standards will be met when the proposal defines the following areas, but not limited specifically to:

1. The Reliability Prediction exceeds the required Specification paragraph 3.2.3.1

2. The worst case environmental conditions are used to calculate the Prediction Reliability values per SOW paragraph 1050.4.1.b

3. A realistic parts count, quality, and stress level is used per SOW paragraph 1050.4.1.b.

Example 3:

AREA: Technical

ITEM: T.1 System Design/Performance

FACTOR: T.1.17 Reliability

DESCRIPTION: This factor involves the review of the offeror's reliability work effort.

STANDARDS: The standards are met when sufficient information is provided to establish high confidence in the compatibility of the offeror's reliability work effort to the system specification requirements. This information should include, but is not specifically limited to:

1. The approach by which the offeror plans on conducting the requirements of SOW paragraphs 1050.4.1.c and d

2. The general compliance of the offeror with ITO paragraph 2.2.

Example 4:

AREA: Technical

ITEM: T.1 System Design/Performance

FACTOR: T.1.16 Reliability and Maintainability Program Plans

DESCRIPTION: This factor involves the review of the offeror's reliability and maintainability program plans.

STANDARDS: The standards are met when the proposal defines the following areas, but is not limited specifically to:

1. Compliance with SOW paragraph 1050.4 and 1050.4.1a, and ITO 2.2

2. Compliance with Specification paragraph 3.2.3 and 3.2.4

3. Reporting structure of R&M engines

4. Corporate policies that impart R&M so as to indicate what priority it has.

5. Size of R&M departments, how many engineers will be assigned to the program and their experience levels.

6. Reasonableness of schedules, milestones, reporting, review of problem areas, and design guidelines.

Example 5:

AREA: Technical

ITEM: T.1 System Design/Performance

FACTOR: T.1.20 Maintainability Prediction

DESCRIPTION: This factor involves the review of the Maintainability Prediction.

STANDARDS: The standards will be met when the offeror indicates compliance with the following areas:

1. The Maintainability requirements of the Specification paragraph 3.2.4.1

2. Maintainability requirements of SOW paragraph 1050.4.1.b and c.

Boiler Plate Standards

The following examples are in a "boiler plate" format and may be tailored to a specific system by referencing appropriate paragraphs from the RFP.

Example 1:

AREA: Technical

ITEM: Reliability

FACTOR: Program Plan

DESCRIPTION: This factor is to evaluate the offeror's reliability program elements of MIL STD 785, which describe the approach and method of accomplishing the reliability requirements of the RFP.

STANDARD: This standard is satisfied when:

1. The offeror has indicated complete understanding and intent to comply with all reliability requirements of the RFP.

2. The offeror defines methods and procedures for meeting the reliability program tasks required by the RFP. This includes methods by which the offeror will ensure that the quantitative reliability requirements are achieved or sufficient justification is given for tradeoffs proposed and deviations requested.

3. Any proposed expansions of the Development Specification requirements are satisfactory and do not reduce the basic specification requirements.

4. The offeror proposes a sound and effective reliability program which defines the approach and describes the method for predicting and allocating system reliability parameters, and optimizing reliability to obtain maximum availability at the lowest life cycle cost.

RFP REFERENCE:

Example 2:

AREA: Technical

ITEM: Maintainability

FACTOR: Design Approach

DESCRIPTION: This factor is to assess the design approach to be applied by the offeror in meeting the quantitative maintainability requirements as well as accomplishing the qualitative maintainability requirements to insure consonance with operational support concept.

STANDARD: This standard is satisfied when:

1. The offeror has indicated complete understanding and intent to comply with all maintainability requirements of the RFP.

2. The offeror proposes a sound and effective maintainability program which defines the approach and describes the method for predicting and allocating

maintainability parameters to obtain maximum availability at lowest life cycle cost.

3. The offeror's proposed inputs to the maintenance concept ensure achievement of availability goals as described in the operational concept in the ICS SOW.

4. The offeror specifies and substantiates effective support elements that will satisfy the operational concept. This includes the following:

a. Levels of maintenance

b. Manhour/skill requirements

c. Downtime

d. Servicing requirements

e. Checkout

f. Calibration/alignment procedures

g. Inspections.

RFP REFERENCES:

Evaluator Questions

The following questions may be used by evaluators to further clarify if an offeror has demonstrated the capability to perform the R&M requirements in the RFP. The questions cover four areas: (1) Reliability Program Plan, (2) Maintainability Program Plan, (3) Built-In-Test (BIT), and (4) Reliability Testing.

Reliability Program Plan

1. Has the offeror explained how the reliability and maintainability (R&M) requirements and concepts will be incorporated into the design and development process (i.e., design reviews, specification reviews, checklists, guidelines, etc.)? Have the R&M engineers' role and authoritative responsibilities been defined?

2. Does the offeror intend to train other departmental managers of the company in the reliability principles, requirements, and goals?

3. Has the offeror identified if it is the role of the reliability and maintainability engineers or mangers to have final drawing and specification sign-off responsibilities before formal design release?

4. Does the offeror provide details concerning the failure review board (who is a member, how often does it meet, what are the topics)? Has the offeror included a System Safety engineer and a representative of manufacturing as a participating member of the failure review board?

5. How does the offeror's stress analysis and predictions computer program relate and compare to the prediction techniques data within MIL HDBK 217D? Will the offeror's design requirements group comply with (as a minimum) the derating requirements of AS-4613 and MIL HDBK 217D?

6. Has the offeror complied with the reliability/ maintainability definitions and failure definitions in accordance with MIL STD 721C and MIL STD 781C?

7. Will the offeror's reliability test data and log books, etc., be made available to the Government Representative (Procuring Activity) at his/her request?

8. Has the offeror submitted the reliability growth rate for each LRU type and the system and submitted the growth rates with the associated growth curves for the system and each LRU?

9. Has the offeror interfaced and used the failure modes, effects, and critical analysis (FMECA) in the system safety program and analysis? Has the offeror indicated that FMECA will be performed in accordance with MIL STD 1629A?

10. Has the offeror's parts control program addressed and included that the program will be performed in accordance with MIL STD 965?

11. Has the offeror provided plans and procedures to translate and analyze the contractual Mean-Time-Between-Failure (MTBFs) to operational Mean-Time-Between-Maintenance (MTBMs); type 1--Inherent, type 2--Induced, type 6--No defect, total; values? What are the MTBM, MTTR, MCTMAX, and Mean-Downtime definitions?

12. Has the offeror determined major decision factors for use in evaluating a trade-off study for a new

design or redesign? Has the offeror identified procedures and evaluation techniques in this type of decision making?

13. Has the offeror provided source data to support and/or back up the field reliability MTBF figures stated within the proposal as proof of past experience? Where did the data come from? How were the MTBFs calculated? How was the data collected and tracked?

14. Within the offeror's proposed reliability program plan, have reliability modeling, reliability predictions, reliability allocations been addressed as required by MIL STD 785B?

Reliability Testing

1. Has the offeror provided information on what type of support equipment will be utilized to support ESS, RDT, RQT, and flight test?

2. Does the offeror plan to conduct burn-in testing (optional for contractor to perform) on all the system LRUs prior to environmental stress screening (ESS)?

3. If the offeror plans to perform burn-in, is it indicated how the failures found during the burn-in testing will be documented and tracked?

4. Has the offeror indicated whether reliability qualification testing will be conducted on a system or LRU basis?

5. Has the offeror indicated if the same test LRUs (systems) used in RDT will be used in RQT and maintainability demonstration?

6. Has the offeror provided the types and quantities of test set chambers to run the ESS, RDT, and RQT testing?

7. Has the offeror explained the ESS, RDT, and RQT testing? Have testing plans, procedures, test duration, failure definitions, test profile, documentation, tracking, and corrective actions of failures been provided?

8. Has the offeror provided a detailed calculation showing how RQT and RDT test time was derived?

9. Has the offeror explained the plans to mount the test samples (system) into the test set chamber?

Built-In-Test (BIT)

1. Is the offeror's BIT program in compliance with MIL STD 415?

2. Has offeror indicated the BIT will be tested under environmental qualification testing, ESS, RDT, and RQT?

3. Will the offeror's BIT be operational during ESS, RDT, and RQT testing?

4. Has the offeror indicated what will be done if the BIT of the system indicates that there is a failure within the system and the automatic test set(s) indicates there is no failure? Or vice versa?

5. Has the offeror indicated how the proposed BIT values were calculated and developed?

6. Does the offeror indicate how BIT failure to detect and isolate are documented and tracked and to whom the documentation is submitted?

7. Does the offeror indicate how the BIT fault data will be displayed at the LRU, SRU, and system levels?

8. Does offeror's BIT monitor and track all the redundant bases in the system?

9. Will the offeror's BIT monitor all the software within the system to detect and isolate software problems?

Maintainability Program Plan

1. Has the offeror developed preliminary MTTR and MCTMAX predictions? Are figures at the SRU and LRU levels and the procedures used in obtaining them provided?

2. Does the offeror have maintainability and their associated studies and tests a major decision factor in the trade-off studies of each design consideration or redesign change?

3. Does the offeror indicate who will have final authority on conducting the maintainability demonstration?

4. Has the offeror provided the scheduled and unscheduled maintenance concept?

Difficulty in Evaluating R&M

The SOW tasks such as test plans and specifications are easier R&M requirements to evaluate. Evaluation of data submitted is a difficult area to evaluate. At times, contractors submit volumes of data. It is up to the evaluator to determine if the data is reasonable or makes sense.

Proposals submitted during the conceptual phase of acquisition are also difficult to evaluate as requirements are vague. There is often no past information available from which to judge the reasonableness of proposals. Future capability is difficult to evaluate. When a system will not be produced for 5-10 years, it must be determined if the contractor will have sufficient capability in the future. Many uncertainties exist in evaluating this area.

Evaluation of R&M during the full scale development and production phases of acquisition are easier. During these phases, R&M tasks and requirements are fully identified; therefore, evaluators know what contractors need to provide in proposals to adequately show R&M capability.

Contractor analysis of R&M includes identification of critical R&M items in the system. It is difficult to dispute the selection of critical items by the contractor. Also, in order to evaluate critical items, the evaluator must be familiar with the data submitted along with

procedures used to collect the data and field maintenance procedures. Contractor R&M predictions also involve an indepth evaluation and are often difficult to dispute.

Maintainability in general is a difficult area to evaluate as it is difficult to conceptualize maintainability on paper. It often takes hands-on experience with a system to identify maintainability problems. Evaluators must often rely on data and designs submitted to determine the maintainability of the system.

Past performance of a contractor on R&M requirements is difficult to evaluate as information is often not available in the source selection on R&M past performance.

The evaluation of R&M budgeted growth curves is difficult. Often times, determination of start points and slopes are a matter of judgement. Data is not available to refute the contractor's submission.

Conclusion

Through the use of this guide, personnel will be aided in the effective development of R&M evaluation criteria and standards. Today, more than ever, with the increasing cost and complexity of weapon systems, the U.S. Air Force must insure that the most reliable and maintainable systems are acquired for the dollars spent.

Bibliography

1. Aeronautical Systems Division (AFSC). The Source Selection Process. A handbook for use by ASD personnel. Wright-Patterson AFB OH: HQ ASD, AFSC, June 1981.

2. Armstrong, Robert, R&M Engineer. Personal interview. HQ ASD/AFES, Wright-Patterson AFB OH, 26 July 1985.

3. Detert, Wallace, R&M Engineer. Personal interview. HQ ASD/TAES, Wright-Patterson AFB OH, 22 July 1985.

4. Liberti, 1st Lt William, USAF, R&M Engineer. Personal interview. HQ ASD/RWEX, Wright-Patterson AFB OH, 26 July 1985.

5. Lucka, William, Division Chief. Personal interview. HQ ASD/ENSI, Wright-Patterson AFB OH, 17 July 1985.

6. McLennan, Roxley K. The Feasibility of a Decision Support System for the Determination of Source Selection Evaluation Criteria. MS thesis, LSSR 84S-42. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1984 (AD-A147 655).

7. Neiman, Clay, R&M Engineer. Personal interview. HQ ASD/AEES, Wright-Patterson AFB OH, 3 July 1985.

8. Papenbrock, Richard, Lead Engineer, Product Assurance. Personal interview. HQ ASD/RWEX, Wright-Patterson AFB OH, 26 July 1985.

9. Read, Robert, R&M Engineer. Personal interview. AFALC, Wright-Patterson AFB OH, 2 August 1985.

10. Secen, 1st Lt Michael, USAF, R&M Engineer. Personal interview. AFALC, Wright-Patterson AFB OH, 17 July 1985.

11. Skantze, Gen Lawrence A., USAF. "Emphasizing Reliability, Maintainability, and Producibility in the Design Process." Headquarters Air Force Systems Command letter, 21 December 1984.

12. U.S. Department of Defense. Maintainability Program for Systems and Equipment. MIL STD 470A. Washington DC: Government Printing Office, 3 January 1983.

13. -----. Major Systems Acquisition Procedures. DOD Instruction 5000.2. Washington DC: Government Printing Office, 3 May 1983.

14. -----. Major Systems Acquisitions. DOD Directive 5000.1. Washington DC: Government Printing Office, 29 March 1982.

15. -----. Reliability and Maintainability. DOD Directive 5000.40. Washington DC: Government Printing Office, 8 July 1980.

16. -----. Reliability Program for Systems and Equipment Development and Production. MIL STD 785B. Washington DC: Government Printing OFfice, 15 September 1980.

17. -----. Selection of Contractual Sources for Major Defense Systems. DOD Directive 4105.62. Washington DC: Government Printing Office, 6 January 1976 (and amended 3 March 1977).

18. U.S. Department of the Air Force. Air Force Reliability and Maintainability. AFR 800-18. Washington DC: Government Printing Office, 15 June 1982.

19. -----. Briefing Formats for Source Selection Actions (AFR 70-15, 22 February 1984). Wright-Patterson AFB OH: Headquarters Aeronautical Systems Division (AFSC), 5 June 1985.

20. -----. Reliability and Maintainability Action Plan R&M 2000. Washington DC: Government Printing Office, 1 February 1985.

21. -----. Reliability and Maintainability of Air Force Weapon Systems - Action Memorandum. Washington DC:, 17 September 1984.

22. -----. Source Selection Plan Preparation Guide. ASDP 800.7. Wright-Patterson AFB OH: Headquarters Aeronautical Systems Division (AFSC), June 1985.

23. -----. Source Selection Policy and Procedures. AFR 70-15. Washington DC: Government Printing Office, 22 February 1984.

24. -----. Source Selection Policy and Procedures. Interim ASD Supplement 1 to AFR 70-15. Wright Patterson AFB OH: Headquarters Aeronautical Systems Division (AFSC), 21 March 1985.

25. Wolanski, Gene, R&M Engineer. Personal interview. HQ ASD/ENSI, Wright-Patterson AFB OH, 10 July 1985.

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This research studied the development of source selection evaluation criteria and standards for reliability and maintainability. The data base consisted of information obtained during personal interviews with personnel from Air Force Systems Command, Aeronautical Systems Division and the Air Force Acquisition Logistics Center. Those interviewed were experienced in the development of source selection criteria and standards for reliability and maintainability.

The research culminated in the establishment of a guide for the development of source selection evaluation criteria and standards for reliability and maintainability. The guide is not specific to a particular type of system or phase in the acquisition process. The guide provides general procedures and areas of consideration for development of criteria and standards which may be applied to various acquisitions.

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